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Record of Decision

for

Operable Unit 2

Marine Corps Air Station

Cherry Point, North Carolina

Atlantic Division
Naval Facilities Engineering Command

Contract Number N62472-90-D-1298

Contract Task Order 0211

September 1998

119504/P

RECORD OF DECISION
FOR
OPERABLE UNIT 2

MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Atlantic Division
Environmental Restoration Branch, Code 1823
Naval Facilities Engineering Command
1510 Gilbert Street
Norfolk, Virginia 23511-2699

Submitted by:
Tetra Tech NUS, Inc.
600 Clark Avenue, Suite 3
King of Prussia, Pennsylvania 19406-1433

(Note: The assests of Brown & Root Environmental were purchased on January 1, 1998 by Tetra Tech NUS, Inc.)

CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0211

SEPTEMBER 1998

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LIST OF ACRONYMS AND ABBREVIATIONS

A	Applicable
ARAR	Applicable or Relevant and Appropriate Requirement
B&R Environmental	Brown and Root Environmental
BEHP	Bis(2-ethylhexyl)phthalate
BGS	Below Ground Surface
BMP	Base Master Plan
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CDI	Chronic Daily Intake
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
CNS	Central Nervous System
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
CY	Cubic Yards
DCE	Dichloroethene
DERA	Defense Environmental Restoration Account
DL	Detection Limit
DON	Department of the Navy
ER-M	Effects Range-Medium
FS	Feasibility Study
GI	Gastrointestinal
HI	Hazard Index
HNUS	Halliburton NUS Environmental Corporation
HpCDD	Heptachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzo-p-furan
HQ	Hazard Quotient
HRS	Hazard Ranking System
HSWA	Hazardous and Solid Waste Amendments
IAS	Initial Assessment Study
ILCR	Incremental Lifetime Cancer Risk
IRP	Installation Restoration Program

kg	Kilogram
L	Liter
LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
MCAS	Marine Corps Air Station
MCL	Maximum Contaminant Level
mg	Milligram
MSL	Mean Sea Level
NA	Not Applicable or Not Analyzed
NC	North Carolina
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environmental and Natural Resources
NCP	National Contingency Plan
ND	Not Detected
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NS	No Standard
O&M	Operation and Maintenance
OCDD	Octachlorodibenzo-p-dioxin
OU	Operable Unit
PAH	Polynuclear Aromatic Hydrocabon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
POL	Petroleum, Oil, and Lubricants
PRAP	Proposed Remedial Action Plan
R&A	Relevant and Appropriate
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RFI	RCRA Facility Investigation
RFA	RCRA Facility Assessment
RfD	Reference Dose
RGO	Remedial Goal Option
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act

SMP	Site Management plan
STP	Sewage Treatment Plant
SVE	Soil Vapor Extraction
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	To Be Considered
TCA	1,1,1-Trichloroethane
TCDD	Tetrachlorodibenzo-p-dioxin
TCE	Trichloroethene
TCL	Target Compound List
TDM	Technical Direction Memorandum
TEF	Toxicity Equivalence Factor
TRC	Technical Review Committee
TSDF	Treatment, Storage, and Disposal Facility
UCL	Upper Confidence Level
UF	Uncertainty Factor
μg	Microgram
USC	United States Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USMC	United States Marine Corps
VOC	Volatile Organic Compound

DECLARATION OF THE RECORD OF DECISION

DECLARATION

Site Name and Location

Operable Unit 2 (Site 10 - Old Sanitary Landfill, Site 44A - Former Sludge Application Area, Site 46 - Polishing Ponds No. 1 and No. 2, and Site 76 - Vehicle Maintenance Area [Hobby Shop])
Marine Corp Air Station
Cherry Point, North Carolina

Statement of Basis and Purpose

This decision document presents the selected remedy for Operable Unit 2 (OU2) at the Marine Corp Air Station (MCAS), Cherry Point, North Carolina. The remedy was chosen in accordance with the federal Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for OU2. Although this remedy is considered the final Record of Decision (ROD) under CERCLA, under the federal Resource Conservation and Recovery Act (RCRA) this remedy is considered an Interim Measure. Currently, the NC Hazardous Waste Section, which administers the RCRA program, has no regulations or guidance in place to allow for any cleanup levels in lieu of residential levels.

The Department of the Navy (DON) and the Marine Corps have obtained concurrence from the State of North Carolina Department of Environment and Natural Resources (NCDENR) and the United States Environmental Protection Agency (USEPA) Region IV on the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from this operable unit, if not addressed by implementing the response action selected in this ROD, may present a potential threat to public health, welfare, or the environment.

Description of Selected Remedy

Operable Unit 2 is one of 15 operable units at MCAS Cherry Point. Separate investigations and assessments are being conducted for these other sites at MCAS Cherry Point in accordance with CERCLA. Therefore, this

ROD applies only to OU2. This remedy calls for the design and implementation of response measures that will protect human health and the environment. This remedy addresses sources of contamination as well as soil and groundwater contamination, which are the principal threats posed by the site.

The selected remedy for groundwater is natural attenuation and institutional controls. The selected remedy for soil and waste is soil vapor extraction and institutional controls.

The major components of the site-wide remedy are:

- Monitored attenuation of groundwater contaminants to remediate the groundwater and contain any future releases from the debris remaining in the landfill.

- In-situ soil treatment by soil vapor extraction at known major soil "hot spots" (secondary source areas) that are contaminated with organics and at any such areas identified during the Remedial Design. This includes monitoring of air emissions and soil to evaluate the effectiveness of treatment.

- Long-term monitoring - MCAS Cherry Point shall conduct long-term monitoring to evaluate the effectiveness of the natural attenuation process. Long-term monitoring will also serve to insure that there are no further releases from the landfill debris still buried at the site, or other contaminated media that will cause unacceptable risks to human health and the environment. A monitoring plan, which shall be prepared and carried out in accordance with federal and State regulations and with the concurrence of USEPA and NCDENR, will be created to detail the frequency, type, and locations of the long-term monitoring samples. The plan shall require collection and analysis of groundwater samples and of surface water and sediment samples from Slocum Creek and Turkey Gut. Based on the results of the monitoring, USEPA or NCDENR may require additional sampling and analysis, and/or remedial actions.

- Institutional Controls, which include land use restrictions and groundwater/aquifer use restrictions as outlined in the Land Use Implementation Control Plan (LUCIP).

- Filing a Notice of Inactive Hazardous Waste Site ("Notice") for OU2 at the Craven County Courthouse. Cancellation of the notice may not occur until it is demonstrated that continued attainment of remediation goals has been achieved.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining on site above that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

_____

Signature (Commanding General,
USMC, MCAS Cherry Point

_____

Date

DECISION SUMMARY

1.0 SITE NAME, LOCATION, AND DESCRIPTION

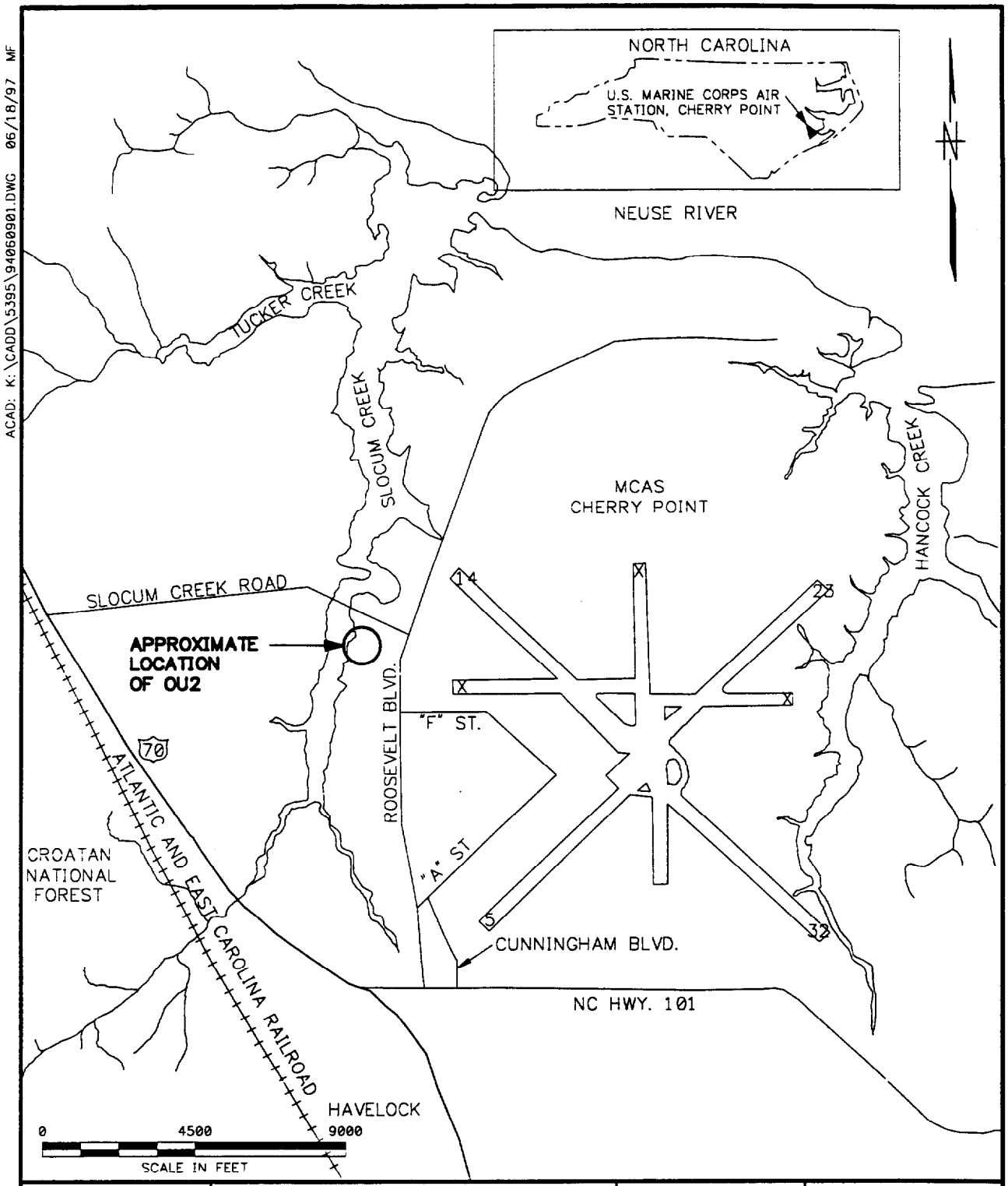
Marine Corps Air Station (MCAS) Cherry Point is part of a military installation located in southeastern Craven County, North Carolina just north of the town of Havelock. The Air Station covers approximately 11,485 acres. Its boundaries are the Neuse River to the north, Hancock Creek to the east, North Carolina Highway 101 to the south, and an irregular boundary line approximately three-quarters of a mile west of Slocum Creek. The entire facility is situated on a peninsula north of Core and Bogue Sounds and south of the Neuse River. The general location of the Air Station is shown on Figure 1-1.

The study area, Operable Unit 2 (OU2), is one of 15 operable units located within MCAS Cherry Point. An "operable unit," as defined by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), is a discrete action that comprises an incremental step toward comprehensively addressing site problems. With respect to MCAS Cherry Point, operable units were developed to combine one or more individual sites where Installation Restoration Program (IRP) activities are or will be implemented.

Operable Unit 2 is located in the west-central portion of the Air Station, as shown on Figure 1-2. It is bounded by the MCAS Cherry Point Sewage Treatment Plant (STP) to the north, Roosevelt Boulevard to the east, a residential area to the south, and Slocum Creek to the west (Figure 1-3). Operable Unit 2, the subject of this ROD, consists of four sites:

- Site 10 - Old Sanitary Landfill (primary component of OU2)
- Site 44A - Former Sludge Application Area
- Site 46 - Polishing Ponds No. 1 and No. 2
- Site 76 - Vehicle Maintenance Area (Hobby Shop)

These sites have been grouped into one operable unit because of their proximity to each other (i.e., Site 44A - Former Sludge Application Area overlies portions of the Site 10 landfill and Site 46 - Polishing Ponds No. 1 and 2 and Site 76 - Vehicle Maintenance Area (Hobby Shop) are located adjacent to the landfill). In addition, Site 44A and Site 46 both contain the same types of suggested contamination derived from sewage treatment.



DRAWN BY HJP DATE 4/9/97	Brown & Root Environmental	CONTRACT NO. 5395	OWNER NO. 0211
CHECKED BY DATE	LOCATION MAP MCAS CHERRY POINT, NORTH CAROLINA	APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 1-1	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

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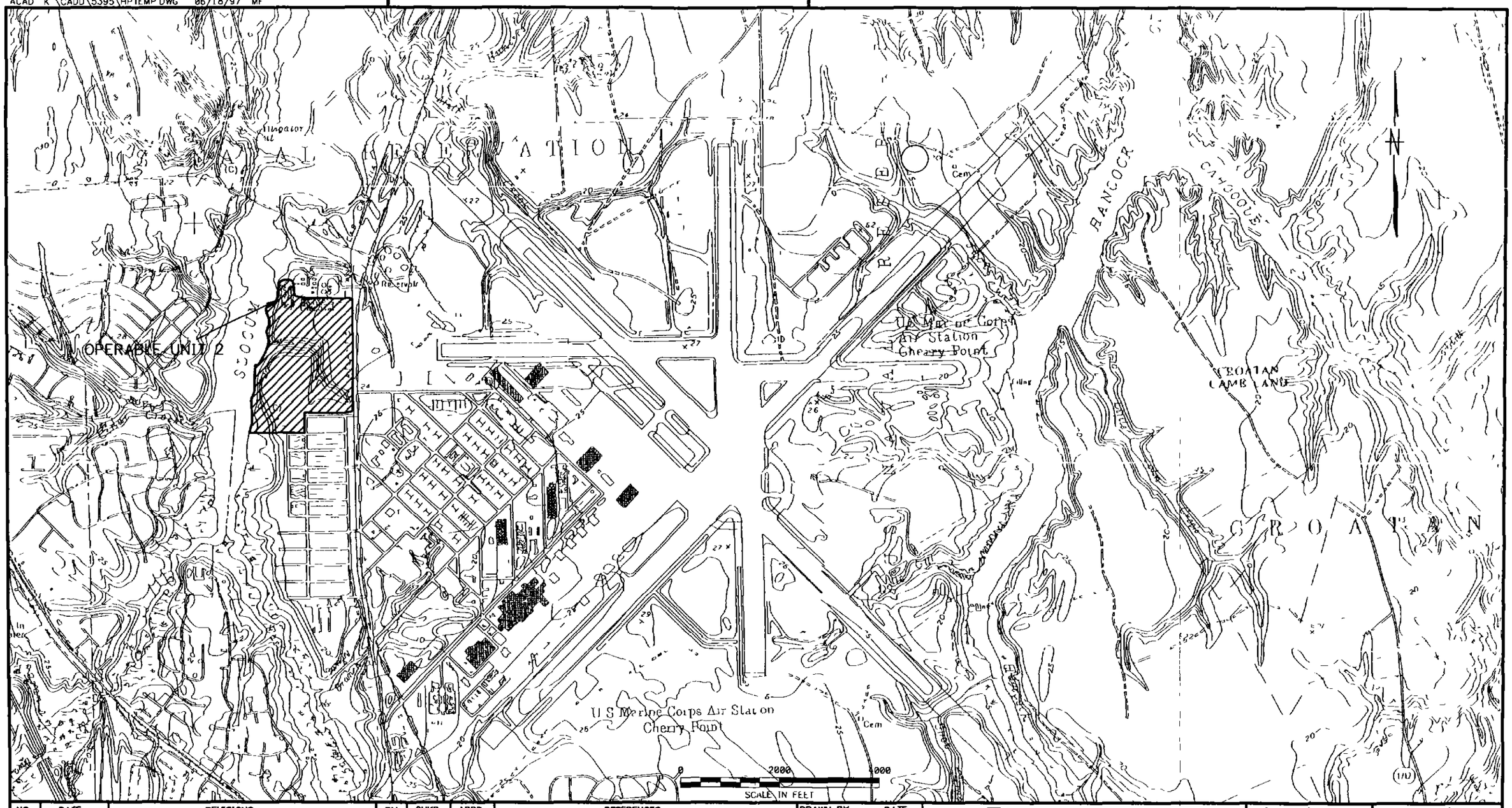

NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 4/16/97
CHECKED BY DATE
COST/SCHED–AREA
SCALE AS NOTED

Brown & Root Environmental

OPERABLE UNIT 2
GENERAL AIR STATION MAP
MCAS CHERRY POINT, NORTH CAROLINA

CONTRACT NO 5395 | OWNER NO 0211
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 1–2 | REV 0

FORM CADD NO. SOUTH_BNLDGN - REV 0 - 02/11/97

98274-03T01Z

ROOSEVELT ROAD

SITE 10-OLD SANITARY LANDFILL

APPROXIMATE LOCATION OF FENCE

GENERAL AREA OF OPERABLE UNIT 2

SITE 43 SEWAGE TREATMENT PLANT

DRUMMED PETROLEUM (ABANDONED)

STORAGE

FORMER SLUDGE IMPOUNDMENT AREA

SITE 44A FORMER SLUDGE APPLICATION AREA

SITE 46 POLISHING POND 2

SITE 46 POLISHING POND 4

GRASSY DRAINAGE SWALE

TURKEY GUT

POSSIBLE FILLED TEPEES

FORMER LOCATION OF PLANES WITH CHARRED AREAS

POSSIBLE RUBBLE AREAS

WASH RACK

MWR STORAGE AREA

SITE 76 VEHICLE MAINTENANCE AREA (HOBBY SHOP)

AUTO HOBBY SHOP

SLOCUM CREEK

REVISIONS

Brown & Root Environmental

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA
ATLANTIC DIVISION
NAVAL STATION
MARINE CORPS AIR STATION CHERRY POINT
CHERRY POINT, NORTH CAROLINA
OU2
GENERAL SITE LOCATION MAP

XX-XX-XXXX
XXXXXX-XX-X-XXXX

FIGURE 1-3

98274-03T022

1.1 SITE 10 - OLD SANITARY LANDFILL

Site 10 is located west of Roosevelt Boulevard and south of Site 43 - Sewage Treatment Plant, on the east side of Slocum Creek. The site consists of a sanitary landfill approximately 40 acres in size. Former sludge impoundments that were closed in the mid-1980s are also located at this site. The sludge impoundment area is included as a hazardous waste management unit in the Air Station's RCRA Part B permit. A fenced, lined area formerly used for storage of drums of petroleum products is also located at Site 10. The area is no longer used for drum storage.

1.2 SITE 44A - FORMER SLUDGE APPLICATION AREA

Site 44 consists of one of two areas in which sludge from the sewage treatment plant was applied. Liquid sludge was removed from the digesters for land application every 30 days. Sludge was applied at Sites 10 and 21. Site 44A is located on Site 10 (OU2), and Site 44B is located on Site 21 (OU13). Site 44B is not discussed further, as it is not an OU2 site. The sludge contained organic material and other constituents that would not be digested during the sewage treatment process. Site 44A is also included as a hazardous waste management unit in the Air Station's RCRA Part B permit.

1.3 SITE 46 - POLISHING PONDS NO. 1 AND 2

This site consists of two inactive unlined ponds that served as aeration basins for wastewater from the Sewage Treatment Plant (STP). The ponds are approximately 12 feet deep. The STP was recently upgraded and does not require the use of the ponds for aeration. The ponds may be used for future stormwater management. Concurrence will be obtained from the USEPA and NCDENR prior to any changes to the current use of these inactive ponds. Site 46 is also included in the Air Station's RCRA Part B permit.

1.4 SITE 76 - VEHICLE MAINTENANCE AREA (HOBBY SHOP)

Site 76 consists of a building and parking lot where personal vehicles are repaired. General auto maintenance and auto body repair are typical work activities conducted at this facility.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Air Station was commissioned in 1942 to maintain and support facilities, services, and materiel of a Marine Aircraft Wing and other units as designated by the Commandant of the Marine Corps.

The following subsections describe the history (i.e., the past land usages and waste disposal practices) of Sites 10, 44A, 46, and 76 and summarize the previous site investigations/enforcement activities.

2.1 SITE HISTORY

Site 10, the Old Sanitary Landfill, served as the primary disposal site at the Air Station from 1955 until the early to mid-1980s. Contaminated material and petroleum, oil, and lubricants (POLs) were landspread, burned, stored in unlined pits, and buried at the landfill. The southern portion of Site 10 was used for fire-training exercises. Former sludge impoundments were located at the Site 10 landfill. These impoundments were closed in the mid-1980s and were used for disposal of metal filings, plating sludges, paints, organic solvents, oil and grease, and miscellaneous chemicals. Closure of the impoundments consisted of sludge excavation, backfilling of the excavations, and capping. The former petroleum storage area is currently inactive and no longer used to store drums of petroleum products.

Site 44A was used for landspreading of digested sludge from the sewage treatment plant. Sludge removed between September and November 1987 was applied at Sites 44A and 44B. Site 44B is part of another operable unit (OU13).

The Site 46 ponds, which are unlined, were used for aeration of sewage treatment plant wastewater. They are no longer in use. A Closure Plan was submitted to the state for this site in December 1988. USEPA Region IV is amenable to waiving the closure requirements and allowing the ponds to be addressed under the NCDENR solid waste management unit (SWMU) authority. Concurrence will be obtained from USEPA and NCDENR prior to any change in use of these ponds.

Site 76 is currently used for maintenance of personal vehicles by Air Station personnel. It is the only site at OU2 that is active.

2.2 PREVIOUS INVESTIGATIONS AND ENFORCEMENT ACTIVITIES

The OU2 sites (10, 44A, 46, and 76) were identified in the Initial Assessment of Sites (IAS) prepared by a Navy contractor. These sites were also included in a multi-task RCRA Section 3008(h) Administrative Order on Consent signed by the Navy and the USEPA in December 1989. MCAS Cherry Point was placed on the National Priorities List (NPL), which was established under CERCLA, in December 1994. As a result, IR investigations are being conducted to meet the requirements of both CERCLA and RCRA.

The nature and extent of contamination at OU2 has been under investigation since 1981. The work was conducted using a phased approach that was based on the availability of funding and the prioritization of sites in terms of potential environmental impacts. The work was conducted under several environmental programs according to regulatory requirements in effect at the time. Information pertaining to these investigations is contained in the following documents:

- Report on Hydrogeology, Contaminants Detected, and Corrective Action/Recommendations for the Former Sludge Impoundments, January 1987 (NUS Corporation): Provides an evaluation of data collected during closure of these impoundments.

- Remedial Investigation Interim Report, October 1988 (NUS Corporation): Provides the results of groundwater, surface water, sediment, and leachate seep sampling and analysis conducted at Site 10 under the IR Program.

- Water Resources Investigations Report 89-615, 1990 (U.S. Geological Survey [USGS]): Provides the results of groundwater sampling and analysis conducted by the USGS.

- Water Resources Investigations Report 89-4200, 1990 (USGS): Provides additional results of groundwater sampling and analysis conducted by the USGS.

- RCRA Facility Investigations Report (RFI) - Units 5, 10, 16, and 17, May 1991 (NUS Corporation): Provides results of additional investigations conducted at Site 10 following signing of the RCRA Consent Order, including soil, surface water, sediment, and groundwater sampling and analysis.

- Evaluation and Recommendations - Unit 10 Former Sludge Impoundment Area, December 1991 (Halliburton NUS Corporation): Provides the results of soil sampling conducted before and after closure of the former sludge impoundment area at Site 10.

- RCRA Facility Investigation and Corrective Measures Study Final Technical Direction Memorandum (TDM) for Units 10 and 16, November 1992 (Halliburton NUS Corporation): Provides the results of additional soil sampling conducted at Site 10 to address data gaps identified upon completion of the RFI.

- RCRA Facilities Investigation (RFI) - 21 Units, June 1993 (Halliburton NUS Corporation): Provides the results of soil sampling and analysis at Site 44A (formerly Site 45) conducted following signing of the RCRA Consent Order.

- Phase II Technical Direction Memorandum, June 1994 (Halliburton NUS Corporation): Provides the results of additional soil sampling conducted to address data gaps identified upon completion of the TDM.

- Remedial Investigation (RI) Report, April 1997 (Brown & Root Environmental): Presents the results of soil, groundwater, surface water, and sediment sampling conducted in 1994; soil and leachate seep data collected in 1995; and surface water, soil, and groundwater data collected in 1996. Summarizes previous data collected from past investigations.

The first remediation activity at OU2 was the closure of the former sludge impoundments at Site 10 in the mid-1980s. The soil vapor extraction system was installed in the major "hot spots" in 1997.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Throughout the site's history, the community has been an active participant in activities in accordance with CERCLA Sections 113(k)(2)(B)(i-v) and 117. In 1988, a Technical Review Committee (TRC) was formed to review recommendations for and monitor progress of the investigation and remediation efforts at MCAS Cherry Point. The TRC was made up of representatives of the Navy, USEPA, U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Forest Service, National Oceanographic and Atmospheric Administration, NCDENR, the Craven County Fire Marshal, and the U.S. Marine Corps. In June 1995, a Restoration Advisory Board (RAB) was established as a forum for communications between the community and decision-makers. The RAB absorbed the TRC and added members from the community. The RAB members work together to monitor progress of the investigations and to review remediation activities and recommendations at MCAS Cherry Point. RAB meetings are held regularly.

The RI/FS and PRAP documents for Operable Unit 2 at MCAS Cherry Point were released to the public in July 1997. These documents were made available to the public in both the Administrative Record and the information repositories maintained at the Havelock Public Library and MCAS Cherry Point Library. The notice of the availability of these two documents was published in the Havelock News on July 16, 1997; the Windsock on July 17,1997; the Carteret County News-Times on July 20, 1997; and the Sun Journal on July 21, 1997. A public comment period was held from July 23, 1997 to August 22, 1997. In addition, a public meeting was held on July 29, 1997. At this meeting, representatives from the Navy, MCAS Cherry Point, USEPA, and NCDENR answered questions about problems at the site and the remedial alternatives under consideration. A response to the comments received during the public comment period is included in the Responsiveness Summary, which is part of this Record of Decision (Section 14). This decision document presents the selected remedial action for OU2, MCAS Cherry Point, North Carolina, chosen in accordance with CERCLA, as amended by SARA, and the National Contingency Plan. The decision for OU2 is based on the Administrative Record.

4.0 SCOPE AND ROLE OF OPERABLE UNIT 2

Fifteen operable units have been defined at MCAS Cherry Point based on contaminant similarity, source similarity, and/or physical proximity of the contaminated sites. The sites that comprise OU2 were combined because of physical proximity to the landfill (Site 10), similar contaminants associated with these sites, and the contaminated groundwater that is beneath or near all of the sites. One operable unit, OU12, has been deferred to the State of North Carolina's underground storage tank program. The remaining operable units at the Air Station are being investigated as part of a comprehensive Air Station investigation. The timing and coordination of these investigations have been addressed in the MCAS Cherry Point Site Management Plan (SMP).

This selected remedy is the first and final remedial action for OU2. The function of this remedy is to reduce risks to human health and the environment associated with exposure to buried wastes and contaminated groundwater and soil.

The potential exposure to contaminated soil and groundwater under a future residential exposure scenario at OU2 constitutes the principal risks to human health. Buried wastes and areas of contaminated soil ("hot spots") are also sources of groundwater contamination. The selected remedy identified in this Decision Summary for contaminated groundwater and soil/waste materials at OU2 will eliminate or minimize future risks to human health and the environment.

The major components of the remedy are:

- Natural attenuation of groundwater.
- An active soil treatment system that includes soil vapor extraction at major "hot spots" (secondary source areas).
- Institutional controls.
- Groundwater, surface water, and sediment monitoring program to ensure that natural attenuation will be effective and to confirm that contaminants are not migrating into the environment. The monitoring program will continue until a five-year review concludes that the alternative has achieved continued attainment of the performance standards (see Table 11-1) and remains protective of human health and the environment.

This remedy addresses the first and final cleanup action planned for OU2, where surficial aquifer groundwater contains elevated concentrations of contaminants. Although this water-bearing zone is affected, the contamination is not affecting the public drinking water supply. The purpose of this proposed action is to prevent current and future potential exposure to buried wastes and contaminated soil and groundwater and to reduce the migration of contaminants.

This is the only ROD contemplated for OU2. Separate investigations and assessments are being conducted for the other sites at MCAS Cherry Point in accordance with CERCLA. Therefore, this ROD applies only to OU2.

5.0 SITE CHARACTERISTICS

This section of the ROD presents an overview of the physical characteristics of OU2.

MCAS Cherry Point is located in the Coastal Plain of North Carolina. Ground surface elevations at OU2 range from 22 to 30 feet at the highest points of Sites 46 and 10, respectively, to approximately 1.5 feet at the banks of Slocum Creek.

Operable Unit 2 is bounded on the west by Slocum Creek, which flows northward past the site. Turkey Gut is a perennial stream that flows through the central portion of Site 10 into Slocum Creek. Turkey Gut separates the northern and southern areas of Site 10. Turkey Gut is a freshwater body, whereas Slocum Creek is a tidal saltwater body. The soils at the site are generally poorly drained and acidic. They are also subject to ponding and seasonal high water tables. Low-lying areas along the streams are subject to flooding.

The knowledge of the stratigraphy at OU2 is derived from published U.S. Geological Survey (USGS) documents and the onsite boring logs. The surficial material at OU2 consists of both fill (sand, silt, and clay mixed with refuse consisting of domestic trash, wood, plastic, rubber, glass, asphalt, concrete, and metal fragments) and natural materials. As much as 26 feet of fill material was noted at Site 10. Generally, the fill material is thickest at the center of the landfill area and thins gradually to the west and abruptly to the east. Natural material at OU2 consists of orange, yellow, and brown silty sand, with trace to some amounts of clay present in localized areas. The natural material, which contains the surficial aquifer, ranges from at least 25 feet thick at Site 46 to a maximum of 52 feet in the southwest portion of OU2.

The surficial aquifer is the uppermost aquifer of the study area and is exposed at the ground surface and in streambeds throughout the Air Station. This aquifer consists of unconsolidated and interfingering beds of fine sand, silt, clay, shell, and peat beds, as well as scattered deposits of coarser-grained material believed to represent relic beach ridges and alluvium. Groundwater beneath the site was encountered in the surficial aquifer at approximately 7 to 22 feet below ground surface (BGS), and water level elevations ranged from approximately 2.6 to 22 feet mean sea level (MSL) in April 1996.

The groundwater in the surficial aquifer flows toward and discharges into either Slocum Creek or Turkey Gut. Polishing Ponds No. 1 and No. 2 (Site 46) are unlined and act as a recharge zone for the surficial aquifer. There are two distinct areas of water table mounding. A large mounding effect at the southeast corner of

OU2 is due to a topographic high. A small mounding effect in the central area is observed in wells that are located near trenches that act as recharge zones.

Underlying the surficial aquifer is the Yorktown confining unit. It consists of an olive green to grayish green, dense, fine sand with varying amounts of shell fragments, clay, and silt. Six borings were extended through this confining unit to install monitoring wells in the Yorktown aquifer. The confining unit has an average thickness of 19 feet, as measured in these six locations. The Yorktown confining layer is continuous throughout OU2.

The Yorktown aquifer is described as a gray silty sand with varying amounts of shell fragments. The groundwater within the Yorktown Aquifer beneath OU2 flows westward and discharges into Slocum Creek. The potentiometric surface (April 1996) of the Yorktown aquifer ranges from approximately 6 to 9.5 feet MSL. Generally, the vertical hydraulic gradients between the surficial and Yorktown aquifers are upward in areas near Slocum Creek and downward in the central and eastern portion of the site.

A dark green, clayey silt and clayey sand was encountered in six of the Lower Yorktown wells at depths ranging from 69 to 100 feet. These materials signify the presence of the underlying Pungo River confining unit. The thickness of this confining unit was not determined because the unit was not penetrated during the drilling activities.

Potable water used at the Air Station and in the adjacent town of Havelock comes from the Castle Hayne aquifers. This unit lies at depths of approximately 195 feet or more below ground surface, below the Pungo River aquifer and the Castle Hayne confining unit. All groundwaters at the Air Station are classified as GA waters by the state of North Carolina. Such groundwater is considered to be an existing or potential source of drinking water.

The Air Station has an active fish and wildlife management program designed to protect all native wildlife species and their habitat, make fish and wildlife resources available on a continuing basis, and enhance fish and wildlife resources. Numerous game and nongame species exist at the Air Station. In addition, the Air Station has management programs for endangered and threatened species known to exist at or migrate through the area. These include the bald eagle, American alligator, red-cockaded woodpecker, and loggerhead turtle. Slocum Creek and its tributaries are designated as a critical environmental area that is considered to be essential to the conservation and management of rare species (both state and Federal).

6.0 NATURE AND EXTENT OF CONTAMINATION

Soil, groundwater, surface water, sediment and leachate seep samples were collected and analyzed for a variety of parameters, in order to determine the nature and extent of contamination.

6.1 SOIL

6.1.1 Surface Soil

Until 1995, five soil samples had been collected at this site from depths of less than 2 feet. Three of these samples were analyzed for target compound list (TCL) volatile and semivolatile organics and target analyte list (TAL) metals. Two of the samples were only analyzed for RCRA List 2 metals. In 1995, thirteen additional surface soil and leachate seep samples were collected and analyzed for the full TCL/TAL, including cyanide. In 1996, two surface samples were collected and analyzed for the full TCL/TAL including cyanide, and two surface soil samples were collected and analyzed for dioxins. Table 6-1 summarizes the surface soil sampling results.

Only a few volatile organic compounds were detected. These include single detections of 1,2-dichloroethene (20 micrograms per kilogram [μg/kg]), methylene chloride (12 μg/kg), and chloroform (9 μg/kg), the first two of which were found at the same location. Xylenes were detected in seven samples at concentrations of 1 to 11 μg/kg, and toluene was found in three samples at concentrations of 11 to 42 μg/kg.

One surface soil sample contained several polynuclear aromatic hydrocarbons (PAHs) at concentrations ranging from 140 μg/kg for indeno(1,2,3-cd)pyrene to 360 μg/kg for pyrene. This sample also contained the highest concentrations of the DDT isomers (33 to 43 μg/kg). Several other pesticides were also detected in surface soils, including chlordanes (1.9 to 29 μg/kg), dieldrin (3.8 to 20 μg/kg), endosulfan I (1.8 to 7.6 μg/kg), endrin aldehyde (3.0 to 27 μg/kg), and heptachlor (2 μg/kg). The maximum concentrations of pesticides were found in various samples throughout the site. Polychlorinated biphenyls (PCBs) were detected in only three surface soil samples at concentrations ranging from 28 μg/kg (Aroclor-1254) to 630 μg/kg (Aroclor-1260).

Dioxins were detected in two surface soil samples. The congeners detected include octachlorodibenzo-p-dioxin (OCDD) and total heptachlorodibenzo-p-dioxin (HpCDD). These are the least toxic of the dioxins.

TABLE 6-1

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL AND DRY LEACHATE SEEP SOIL (0 TO 2 FEET) - OPERABLE UNIT 2 MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections	Background Concentration[1]
Volatile Organics (μg/kg)				
Toluene	3/18	21.7	11 - 42	6.1
Xylenes	7/18	3.7	1 - 11	6.9
1,2-Dichloroethene (total)	1/18	20	20	ND[2]
Methylene chloride	1/18	12	12	4[3]
Chloroform	1/18	9	9	5[3]
Semivolatile Organics (μg/kg)				
2,4-Dinitrophenol	1/15	850	850	ND
4-Nitrophenol	1/15	850	850	ND
Di-n-octylphthalate	2/15	128.5	67-190	ND
Benzo(a)anthracene	1/15	160	160	ND
Benzo(b)fluoranthene	1/15	170	170	ND
Benzo(k)fluoranthene	1/15	160	160	ND
Benzo(g,h,i)perylene	1/15	250	250	ND
Benzo(a)pyrene	1/15	240	240	ND
Chrysene	1/15	220	220	ND
Fluoranthene	1/15	270	270	ND
Indeno(1,2,3-cd)pyrene	1/15	140	140	ND
Pyrene	1/15	360	360	ND
Pesticides/PCBs/Dioxins/Furans (μg/kg)				
alpha-Chlordane	7/15	8.9	1.9 - 27	1.20
gamma-Chlordane	2/15	20.5	12 - 29	1.09
4,4'-DDD	2/15	23.4	3.8 - 43	2.36
4,4'-DDE	6/15	22.9	4.2 - 69	0.625[3]
4,4'-DDT	7/15	14.4	4.7 - 35	0.56[3]
Dieldrin	4/14	10.7	3.8 - 20	1.1[3]
Endosulfan I	2/15	4.7	1.8 - 7.6	0.43[3]
Endrin aldehyde	6/14	10.7	3.0 - 27	ND
Heptachlor	1/15	2.0	2.0	0.045[3]
Aroclor-1254	2/15	29.5	28-31	ND
Aroclor-1260	1/15	630	630	ND
OCDD	2/2	0.58	0.141-1.012	NA[4]
Total HpCDD	1/2	0.026	0.026	NA[4]

TABLE 6-1 (Continued)
SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL AND DRY LEACHATE SEEP SOIL
(0 TO 2 FEET) - OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections	Background Concentration[1]
Inorganics (mg/kg)				
Aluminum	18/18	4,541	1190 - 13,000	9,268
Antimony	4/18	2.3	1.1 - 3.6	ND
Arsenic	20/20	2.4	0.68 - 17.1	4.54
Barium	20/20	24.7	3.3 - 103	14.4
Beryllium	1/20	0.28	0.28	0.26
Cadmium	8/20	2.0	0.29 - 6.4	0.65
Calcium	17/18	20,416	210 - 209,000	693
Chromium	20/20	14.0	2.2 - 51.2	12.8
Cobalt	13/20	0.73	0.22 - 1.6	1.63
Copper	18/20	11.0	1.1 - 50.8	3.08
Iron	18/18	8,552	1,520 - 54,700	4,959
Lead	17/20	29.3	3.8 - 76.5	7.92
Magnesium	14/18	678	236 - 2,180	383
Manganese	18/18	37.3	3.7 - 211	14.1
Mercury	10/18	0.30	0.06 - 1.0	0.11
Nickel	15/20	2.2	0.35 - 5.4	4.29
Potassium	12/18	578	189 - 1140	390
Selenium	6/20	0.98	0.30 - 3.1	0.38
Silver	2/20	2.1	0.43 - 3.7	0.46
Sodium	8/18	124	40.3 - 424	59.2
Thallium	3/20	2.6	0.47 - 6.7	0.48[3]
Vanadium	19/20	9.7	3.2 - 24.2	15.5
Zinc	19/20	43.1	4.8 - 209	10.6

(1) Upper 95% Confidence Limit (UCL) concentration.
(2) ND - Not detected.
(3) 95% UCL exceeded the maximum background concentration; therefore, maximum is reported.
(4) NA - Not analyzed.

Dioxins are evaluated using Toxicity Equivalence Factors (TEFs) relative to the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). TCDD equivalent concentrations ranged from 0.0001 to 0.001 μg/kg.

Metals of interest in the surface soil samples were cadmium, chromium, manganese, and thallium, which were detected at maximum concentrations of 6.4 mg/kg, 51.2 mg/kg, 211 mg/kg, and 6.7 mg/kg, respectively. No single sample location contained an overwhelming majority of the detected maximums. The maximum values were detected at a number of sample locations.

6.1.2 Subsurface Soil

Past soil sampling programs were based on soil-gas and geophysical surveys, aerial photographs, and knowledge of existing groundwater contamination. When anomalous areas or areas of groundwater contamination were identified, soil borings and test pits were installed to collect subsurface soil samples. Table 6-2 summarizes the subsurface soil sampling results.

The analytical results for subsurface soil show that volatile organic compounds were not detected frequently, but were detected at notable concentrations in a limited number of samples. In addition, only a limited number of samples were analyzed for semivolatile organic compounds and pesticides/PCBs. Fuel-type constituents, including benzene, toluene, ethylbenzene, and xylenes (BTEX), were identified in a number of subsurface soil samples. The vast majority of samples analyzed for BTEX did not contain these compounds at detectable levels. The primary detections were scattered throughout the site, with the highest concentrations reported in the areas used for fire training exercises in the southern portion of the landfill. The highest concentrations of BTEX (primarily, toluene, ethylbenzene, and xylenes, with lower concentrations of benzene) ranged from 155,280 to 617,000 μg/kg. The sample with the lower concentration was collected near the water table. All other sample intervals were above the water table.

Other areas with BTEX contamination were in the area of the former sludge impoundments (1,900 to 7,500 μg/kg); one boring south of Turkey Gut (4,830 μg/kg); and in the east-central portion of the site (2,174 to 10,993 μg/kg). All of the samples in these areas were collected from above the water table. The presence of these constituents in soil appears to suggest potential source area(s) for BTEX in groundwater.

Another group of compounds potentially relating to observed groundwater contamination are chlorinated solvents such as tetrachloroethene (PCE), trichloroethene (TCE), dichloroethenes (DCE), vinyl chloride, and 1,1,1-trichloroethane (TCA). While not widespread, their presence also appears to correlate with observed areas of these compounds in the surficial aquifer. There are a few areas with chlorinated solvents in the soil,

TABLE 6-2

SUBSURFACE SOIL ANALYTICAL RESULTS (> 2 FEET)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Concentration Range	Frequency of Detection	Background Concentration[1]
Volatile Organics (µg/kg)			
Acetone	4 - 5,300	24/111	100[2]
2-Butanone	11 - 16,000	15/111	5[2]
4-Methyl-2-pentanone	10 - 1,000	5/111	ND[3]
2-Hexanone	7 - 510	7/111	ND
Benzene	4 - 280	7/115	ND
Toluene	5 - 67,000	20/115	6.1
Ethylbenzene	7 - 140,000	19/115	4[2]
Xylenes (total)	5 - 450,000	32/111	6.9
Chlorobenzene	14 - 520	7/115	ND
Styrene	5	1/111	ND
1,1,1-Trichloroethane	3 - 2,500	15/115	ND
1,1-Dichloroethane	9 - 69	4/115	ND
1,2-Dichloroethane	13	1/115	ND
Chloroethane	14	1/115	ND
Tetrachloroethene	38 - 4,800	2/111	ND
Trichloroethene	5 - 880	7/115	ND
1,2-Dichloroethene (total)	5 - 4,700	6/111	ND
Vinyl chloride	13 - 490	2/115	ND
Chloroform	470 - 2,590	4/115	5[2]
Methylene chloride	4 - 190,000	16/115	4[2]
Trichlorofluoromethane	4.9 - 24	4/4	ND
trans-1,3-Dichloropropene	98	1/115	ND
Carbon disulfide	6 - 44	7/111	ND
Semivolatile Organics (µg/kg)			
Phenol	43 - 12,000	4/20	ND
2,4-Dimethylphenol	52 - 4,100	5/20	ND
4-Methylphenol	590 - 27,000	2/16	ND
1,2-Dichlorobenzene	430 - 2,000	2/20	ND
Bis(2-ethylhexyl)phthalate	49 - 11,000	9/20	75[2]
Di-n-butylphthalate	110 - 360	5/20	261

TABLE 6-2 (Continued)
SUBSURFACE SOIL ANALYTICAL RESULTS (> 2 FEET)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Concentration Range	Frequency of Detection	Background Concentration[1]
Diethylphthalate	55 - 160	2/20	ND
Butylbenzylphthalate	140 - 2,300	2/20	ND
Anthracene	1,000	1/20	ND
Fluoranthene	1,100	1/20	ND
Fluorene	420 - 20,000	4/20	ND
2-Methylnaphthalene	140 - 230,000	8/16	ND
Naphthalene	100 - 39,000	9/20	ND
Phenanthrene	200 - 90,000	6/20	ND
Pyrene	190	1/20	ND
Dibenzofuran	4,300 - 11,000	2/16	ND
Pesticides/PCBs (µg/kg)			
Aldrin	3.6	1/14	ND
delta-BHC	4.6	1/14	ND
alpha-Chlordane	3.9 - 630	3/9	1.20
gamma-Chlordane	1.2 - 2.8	3/10	1.09
4,4'-DDD	1.4 - 3.5	4/11	2.36
4,4'-DDE	2.5 - 30	2/13	0.625[2]
4,4'-DDT	120 - 130	2/13	0.56[2]
Dieldrin	7.2 - 53	4/14	1.10[2]
Endosulfan I	2.2	1/14	0.43[2]
Endosulfan II	32 - 47	2/12	0.64[2]
Endosulfan sulfate	36 - 67	2/14	ND
Endrin	15 - 21	2/14	ND
Heptachlor epoxide	7.7 - 18	2/12	ND
1,2,3,4,6,7,8-HpCDD	0.0404	1/2	NA[4]
1,2,3,4,6,7,8-HpCDF	0.0061	1/2	NA
OCDD	0.210-0.651	2/2	NA

TABLE 6-2 (Continued)
SUBSURFACE SOIL ANALYTICAL RESULTS (> 2 FEET)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Concentration Range	Frequency of Detection	Background Concentration[1]
Total HpCDD	0.0404	1/2	NA
Total HpCDF	0.0075	1/2	NA
Inorganics (mg/kg)			
Aluminum	467 - 18,500	32/32	9,268
Antimony	3.9 - 66.3	15/111	ND
Arsenic	0.12 - 13.7	113/118	4.54
Barium	1.0 - 705	38/40	14.4
Beryllium	0.02 - 3.7	38/117	0.26
Cadmium	0.14 - 119.5	26/127	0.65
Calcium	49.7 - 105,000	32/32	693
Chromium	1.1 - 122	120/127	12.8
Cobalt	0.50 - 16.7	14/34	1.63
Copper	0.24 - 2,370	76/127	3.08
Iron	717 - 62,600	32/32	4,959
Lead	0.82 - 1,650	118/127	7.92
Magnesium	25.3 - 3,440	32/32	383
Manganese	2.7 - 1,170	32/32	14.1
Mercury	0.04 - 4.1	12/115	0.11
Nickel	1.0 - 176	54/127	4.29
Potassium	54.6 - 2,040	22/32	390
Selenium	0.02 - 1.5	38/117	0.38
Silver	0.09 - 90.0	11/125	0.46
Sodium	30.6 - 2,250	19/32	59.2
Thallium	0.12 - 7.4	6/117	0.48[2]
Vanadium	4.0- 27.2	27/34	15.5
Zinc	0.58 - 2,650	113/127	10.6

(1) Upper 95% Confidence Limit (UCL) concentration.
(2) 95% UCL exceeded the maximum background concentration; therefore, maximum is reported.
(3) ND - Not detected.
(4) NA - Not analyzed.

such as south of Turkey Gut (DCE at 6 to 4,700 µg/kg and vinyl chloride at 490 µg/kg), the area of the former sludge impoundments (PCE at 4,800 µg/kg, TCE at 800 to 880 µg/kg, and TCA at 2,500 µg/kg) and in the east-central portion of the site (PCE at 38 µg/kg). All samples in these areas were collected above the water table.

Other compounds of note in the subsurface soil include several phenols found in the area of the former sludge impoundments. These compounds and the maximum concentrations included phenol (12,000 µg/kg), 2,4-dimethylphenol (4,100 µg/kg), and 4-methylphenol (27,000 µg/kg). All samples in this area were collected above the water table. In addition, several of the more soluble PAHs were detected in the area formerly used for fire-training exercises in the southern portion of the landfill. The highest concentrations were reported for fluorene (20,000 µg/kg), phenanthrene (90,000 µg/kg), naphthalene (39,000 µg/kg), and 2-methylnaphthalene (230,000 µg/kg). The depth interval was at the water table.

Fourteen samples were collected and analyzed for pesticides, which produced infrequent detections. Dieldrin was one of the most commonly detected pesticides and was found at a maximum concentration of 53 µg/kg in the former sludge impoundment area. Other pesticides of note were chlordanes (630 µg/kg maximum) and 4,4'-DDD (3.5 µg/kg maximum). The maximum concentrations of these pesticides were detected in the southern portion of the landfill. Many of the maximum concentrations of these and other pesticides were found at depths greater than 10 feet. This may indicate soil mixing or application of pesticides for insect control when various areas were receiving waste material.

Dioxins and furans were detected in two subsurface soil samples. Congeners detected include OCDD, HpCDD, and heptachlordibenzo-p-furan (HpCDF). These are the least toxic of the dioxins and furans. TCDD equivalent concentrations ranged from 0.0003 to 0.0011 µg/kg.

Ketones were detected in several samples. Acetone was detected at concentrations up to 5,300 µg/kg (southern portion of landfill), and 2-butanone was detected up to 16,000 µg/kg (east-central portion of site).

A number of metals were detected in the subsurface soil samples. Many metals were detected in 90 percent or more of the samples, with the following metals detected less frequently: antimony (14 percent), mercury (10 percent), beryllium (32 percent), cadmium (20 percent), cobalt (41 percent), copper (60 percent), nickel (43 percent), selenium (32 percent), silver (9 percent), thallium (5 percent), and vanadium (79 percent). Metals that were detected in at least 90 percent of the samples include aluminum, arsenic, barium, calcium, chromium, iron, lead, magnesium, manganese, potassium, sodium, and zinc. Several of the metals,

including arsenic, vanadium, and zinc, were detected at concentrations that are not significantly different from the background concentration range. The metals whose maximum detected concentrations exceeded the background results the greatest were antimony, barium, cadmium, copper, lead, manganese, and silver. These were not widespread or common contaminants in subsurface soil at Operable Unit 2, although there are a limited number of locations with high concentrations. Copper, lead, and zinc were those metals which were detected most frequently at concentrations greater than background and which appeared to be the most widespread.

6.1.3 Migration of Soil Contaminants to Groundwater

Remedial Goal Options (RGOs) based on potential movement of contaminants from soil to groundwater were developed as part of the RI according to Method II Category S-3 contained in the North Carolina Risk Analysis Framework guidance. Method II uses a transport model to calculate soil target concentrations that would not likely exceed the groundwater target concentrations. The groundwater target concentrations were either state Class GA groundwater standards or risk-based concentrations, for chemicals with no numerical groundwater standard. Soil RGOs were developed for any chemical ever detected in groundwater that exceeded the state groundwater standard plus products of potential chemical transformations. Table 6-3 provides the Category S-3 soil RGOs along with the maximum soil concentrations detected for each chemical. The following chemicals exceeded RGOs based on protection of groundwater: benzene, 2-butanone, chlorobenzene, chloroform, 1,2-dichloroethane, cis- and trans-1,2-dichloroethene, trans-1,3-dichloropropane, ethylbenzene, methylene chloride, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, 2,4-dimethylphenol, 2-methylnaphthalene, 4-methylphenol, naphthalene, dieldrin, heptachlor epoxide, cadmium, iron, lead, manganese, nickel, and silver. Figures 6-1 and 6-2 show the locations that exceed these RGOs for organics and inorganics, respectively. Results for iron are not shown because the calculated RGO was lower than the background concentration range.

6.2 GROUNDWATER AND SURFACE WATER

6.2.1 Surficial Aquifer

Table 6-4 summarizes the most recent surficial aquifer groundwater sampling results. Figure 6-3 shows the locations where state groundwater standards were exceeded. The most commonly detected contaminants in the surficial aquifer were monocyclic aromatic fuel constituents (BTEX), halogenated aliphatics (chlorinated solvents and breakdown products such as tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE), vinyl chloride, 1,1,1-trichloroethane (TCA), dichloroethanes (DCA), and chloroethane), and chlorinated

TABLE 6-3

REMEDIAL GOAL OPTIONS FOR SOIL - PROTECTION OF GROUNDWATER
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	S-3 Target Concentration	Maximum Soil Concentration
Volatiles (µg/kg)		
Benzene*[1]	5.6	280
Bromodichloromethane	2.9	ND[2]
2-Butanone*	687	16,000
Carbon tetrachloride	2.9	ND
Chlorobenzene*	432	520
Chloroethane	13,848	14
Chloroform*	0.96	2,590
Chloromethane	6.7	ND
Dibromochloromethane	0.69	ND
1,1-Dichloroethane	3,521	69
1,2-Dichloroethane*	1.7	13
1,1-Dichloroethene	49.2	ND
cis-1,2-Dichloroethene*	350	4,700 (total)[3]
trans-1,2-Dichloroethene*	400	4,700 (total)[3]
1,2-Dichloropropane	2.8	ND
cis-1,3-Dichloropropene	1.2	ND
trans-1,3-Dichloropropene*	1.2	98
Ethylbenzene*	343	140,000
2-Hexanone	760	510
Methylene chloride*	21.9	190,000
4-Methyl-2-pentanone	2,500	1,000
1,1,2,2-Tetrachloroethane	0.31	ND
Tetrachloroethene*	5.9	4,800
Toluene*	8,111	67,000
1,1,1-Trichloroethane*	1,484	2,500

TABLE 6-3 (Continued)
REMEDIAL GOAL OPTIONS FOR SOIL - PROTECTION OF GROUNDWATER
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	S-3 Target Concentration	Maximum Soil Concentration
1,1,2-Trichloroethane	0.96	ND
Trichloroethene*	20.7	880
Vinyl chloride*	0.09	490
Semivolatiles (µg/kg)		
Bis(2-chloroethyl)ether	0.04	ND
Bis(2-ethylhexyl)phthalate	906,000	11,000
2,4-Dimethylphenol*	1,194	4,100
2-Methylnaphthalene*	3,235	230,000
2-Methylphenol	2,097	ND
4-Methylphenol*	205	27,000
Naphthalene*	925	39,000
Nitrobenzene	3.6	ND
2-Nitrophenol	2,346	ND
Pesticides (µg/kg)		
Aldrin	203	3.6
alpha-BHC	0.31	ND
beta-BHC	1.1	ND
4,4'-DDD	5,601	43
4,4'-DDE	17,881	69
4,4'-DDT	10,521	130
Dieldrin*	1.8	53
Endosulfan I	2,059	7.6
Endosulfan II	2,059	47
Endrin aldehyde	348	27
Heptachlor	226	2.0
Heptachlor epoxide*	6.7	18

TABLE 6-3 (Continued)
REMEDIAL GOAL OPTIONS FOR SOIL - PROTECTION OF GROUNDWATER
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	S-3 Target Concentration	Maximum Soil Concentration
Metals (mg/kg)		
Arsenic	26.2	17.1
Cadmium*	2.7	119.5
Chromium	21,000	122
Iron*	151	62,600
Lead*	270	1,650
Manganese*	65.2	1,170
Nickel*	56.4	176
Silver*	0.22	90

1 Asterisk indicates exceedance of target concentration.
2 Not detected.
3 Samples were analyzed for total 1,2-dichloroethene.

LEGEND

- 1990 1991 SOIL BORING
- TEST PIT
- 1983 SOIL BORING
- 1993 SOIL BORING
- 1994/1996 SOIL BORING
- SOIL BORING/MAGNETOMETER DATA POINT
- 1995 SURFACE SOIL
- 1995 1996 SURFACE SOIL

18TP18

1,2-DICHLOROETHANE	13 (8-10)

PARAMETER — DEPTH INTERVAL — CONCENTRATION (UG/KG)

POLISHING POND

POLISHING POND

SLOCUM CREEK

SEWAGE TREATMENT PLANT

DRUMMED PETROLEUM (ABANDONED)

DECON PAD

FORMER SLUDGE APPLICATION AREA

STORAGE

18B83

2-BUTANONE	[illegible]
2-BUTANONE	1200 (8-10)
2,4 DIMETHYLPHENOL	4100 (8-10)
4-METHYLPHENOL	27,000 (8-10)
DIELDRIN	53 (8-10)
HEPTACHLOR EPOXIDE	15 (8-10)

B2 14

CHLOROFORM	470 (14)
METHYLENE CHLORIDE	1150 (14-)

SI583

2-BUTANONE	2200 (10 10)
ETHYLBENZENE	800 (10-10)
TETRACHLOROETHENE	4000 (10 10)
NAPHTHALENE	8700 (10-10)
2-METHYLNAPHTHALENE	21,000 (10 10)

SI584

2-BUTANONE	1000 (12-14)
2-BUTANONE	2200 (8-10)
METHYLENE CHLORIDE	97000 14)
ETHYLBENZENE	940 (8 10)
2 METHYLNAPHTHALENE	21,000 (8 10)
NAPHTHALENE	830 (12-14)
NAPHTHALENE	10,000 (8 10)

B1-14

CHLOROFORM	2500 (14)
METHYLENE CHLORIDE	380 (14)

SB/SB-C

CHLOROFORM	1000 (10-14.5)
METHYLENE CHLORIDE	2530 (10 14.5)

18B8

NAPHTHALENE	6,500 (10-12)
DIELDRIN	34 (10 12)
HEPTACHLOR EPOXIDE	77 (10-12)

B3/B4 C

CHLOROFORM	1400 (10-14.5)
METHYLENE CHLORIDE	559 (10-14.5)

OU2SB8

CHLOROFORM	9 (8 1)
DIELDRIN	20 (8 1)

18B84

TRICHLOROETHENE	880 (10-12)

SI581

2-BUTANONE	1500 (10-12)
METHYLENE CHLORIDE	1300 (10-12)
2 METHYLNAPHTHALENE	7100 (10-12)
NAPHTHALENE	2600 (10 12)

18B82

ETHYLBENZENE	610 (12 14)
1,1,1 TRICHLOROETHANE	2500 (6-8)
TRICHLOROETHENE	880 (6-8)
TRICHLOROETHENE	880 (12-14)

18TP18

BENZENE	11 (8-10)
1,2-DICHLOROETHANE	13J (8-10)
1,2-DICHLOROETHANE (TOTAL)	900 (8 10)

OU2SB2

DIELDRIN	8 1 (8 1)

18TP17

BENZENE	9 (9-10)

18SB-E83

BENZENE	130 (2-4)
1,2-DICHLOROETHENE (TOTAL)	4700 (2 4)
METHYLENE CHLORIDE	86 (2 4)
VINYL CHLORIDE	490 (2 4)

18SB B5

BENZENE	2400 (8)
METHYLENE CHLORIDE	36 (8-10)
1,2-DICHLOROETHENE(TOTAL)	1100 (8 10)
TRICHLOROETHENE	8100 (8-10)

OU2SB1

DIELDRIN	11 (8-1)

18TP14

ETHYLBENZENE	1300 (12 14)

18TP23

VINYL CHLORIDE	13 (9-10)

OU2SB4

4-METHYLPHENOL	590 (22-24)
DIELDRIN	7.2 (22-24)

18TP10

ETHYLBENZENE	14,000 (4-6)
ETHYLBENZENE	140,000 (9-10)
METHYLENE CHLORIDE	63000 (4 6)
METHYLENE CHLORIDE	190000 (9-10)
TOLUENE	27,000 (9-10)

18TP02

BENZENE	33 (4 6)
2-BUTANONE	16,000 (4-6)
METHYLENE CHLORIDE	360 (4 6)
ETHYLBENZENE	350 (4 6)
TETRACHLOROETHENE	36 (4 6)
TRANS-1,3-DICHLOROPROPENE	98 (4-6)
TRICHLOROETHENE	140 (4 6)

OU2SB7

ETHYLBENZENE	28,000 (22-24)
TOLUENE	87,000 (22-24)
2-METHYLNAPHTHALENE	51,000 (22-24)
NAPHTHALENE	16,000 (22-24)
DIELDRIN	7.2 (22 24)

18TP04

CHLOROBENZENE	520 (10 12)

OU2SB6

BENZENE	200 (22-24)
ETHYLBENZENE	24,000 (22-24)
TOLUENE	31,000 (22-24)
2 METHYLNAPHTHALENE	230,000 (22 24)
NAPHTHALENE	34,000 (22 24)

OU2SB5

ETHYLBENZENE	440 (22-24)
2-METHYLNAPHTHALENE	16,000 (22-24)
NAPHTHALENE	11,000 (22-24)

OU2SB12

DIELDRIN	3.6 (8 1)

0 100 200
SCALE IN FEET

K:\CADD\539\539KT06.DGN 6 20 97 MF

SEPTEMBER 1998

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CTO 211

FIGURE 6-1

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION — NORFOLK, VIRGINIA
MARINE CORPS AIR STATION CHERRY POINT — CHERRY POINT NORTH CAROLINA
OU2

ORGANIC CONSTITUENTS IN SOIL EXCEEDING FGDs

Brown & Root Environmental

ACTIVITY — SATISFACTORY TO

REVISIONS

98274-03T032

98279-03202

REVISIONS

NO.	DESCRIPTION	DATE	APPROVED

Brown & Root Environmental

ACTIVITY — SATISFACTORY TO

INORGANIC CONSTITUENTS IN SOIL EXCEEDING PGOs

OU2

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

MARINE CORPS AIR STATION CHERRY POINT CHERRY POINT, NORTH CAROLINA

FIGURE 6-2

CTO 211

6-15

REVISION 3
SEPTEMBER 1998

STORAGE

DRUMMED PETROLEUM (ABANDONED)

FORMER SLUDGE APPLICATION AREA

DECON PAD

POLISHING POND

POLISHING POND

SLUDGE CREEK

LEGEND

- 1994/1996 SOIL BORING
- TEST PIT
- 1983 SOIL BORING
- 1992 SOIL BORING
- SOIL BORING/MAGNETOMETER DATA POINT
- 1993/1996 SURFACE SOIL

PARAMETER

CONCENTRATION (mg/kg)

DEPTH INTERVAL

119504/P

TABLE 6-4

SUMMARY OF ANALYTICAL RESULTS - SURFICIAL AQUIFER (1994 AND 1996)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections	Background Range	NC Class GA Standard[4]
Volatile Organics (µg/L)					
Acetone	3/9	19.0	7 - 32	NA	700
2-Butanone	2/17	76.0	69 - 83	NA	170
2-Hexanone*[5]	1/46	1	1	NA	> DL[6]
4-Methyl-2-pentanone*	5/46	17.0	3 - 64	NA	> DL
Benzene*	21/46	19.6	2 - 230	NA	1
Toluene	7/46	41.6	2 - 110	NA	1,000
Ethylbenzene*	7/46	13.0	1 - 38	NA	29
Xylenes	11/46	49.9	2 - 180	NA	530
Chlorobenzene*	22/46	42.3	1 - 180	NA	50
1,2-Dichlorobenzene[1]	15/76	8.5	0.75 - 28	NA	620
1,3-Dichlorobenzene[1]	2/79	2	2	NA	620
1,4-Dichlorobenzene[1]	26/79	10.7	2.5 - 40	NA	75
1,1,1-Trichloroethane	2/46	4	3 - 5	NA	200
1,1-Dichloroethane	18/46	27.6	1 - 79	NA	700
1,2-Dichloroethane*	3/46	3.7	2 - 5	NA	0.38
Chloroethane	12/46	27.3	1 - 90	NA	2,800
Tetrachloroethene*	6/46	7.4	1 - 21	NA	0.7
Trichloroethene*	11/46	11.3	1 - 40	NA	2.8
1,1-Dichloroethene	1/46	2	2	NA	7
cis-1,2-Dichloroethene*	16/46	29.2	1 - 140	NA	70
trans-1,2-Dichloroethene	6/46	1.8	0.75 - 3	NA	70
Vinyl chloride*	16/46	8.3	1 - 26	NA	0.015
Methylene chloride	3/45	1.5	1 - 2	NA	5
1,2-Dichloropropane*	5/46	1.2	1 - 2	NA	0.56
Chloroform*	2/46	2	1 - 3	NA	0.19
Semivolatile Organics (µg/L)					
Phenol	4/33	8.3	3 - 16	NA	300
2-Methylphenol*	2/33	8.5	6 - 11	NA	> DL
4-Methylphenol*	5/33	32.7	3 - 65	NA	> DL
2,4-Dimethylphenol*	4/33	77.3	4 - 280	NA	> DL
Bis(2-ethylhexyl)phthalate*	3/33	33.0	4 - 66	NA	3
Diethylphthalate	9/33	18.2	4 - 53	NA	5,000
2-Methylnaphthalene*	4/33	8.3	4 - 18	NA	> DL
Naphthalene*	8/33	14.6	3 - 41	NA	21
Nitrobenzene*	1/33	5	5	NA	> DL
Bis(2-chloroethyl)ether*	1/33	3	3	NA	> DL

TABLE 6-4 (Continued)
SUMMARY OF ANALYTICAL RESULTS - SURFICIAL AQUIFER (1994 AND 1996)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections	Background Range	NC Class GA Standard
Pesticides/PCBs (µg/L)					
Aldrin*	1/32	0.0034	0.0034	NA	> DL
alpha-BHC*	2/30	0.0094	0.0089 - 0.0098	NA	> DL
gamma-BHC (Lindane)	2/28	0.024	0.0089 - 0.041	NA	0.2
alpha-Chlordane	5/30	0.0009	0.0054 - 0.014	NA	0.027
gamma-Chlordane	1/31	0.0085	0.0085	NA	0.027
4,4'-DDE*	1/30	0.0092	0.0092	NA	> DL
4,4'-DDT*	1/31	0.017	0.017	NA	> DL
Endosulfan I*	1/32	0.0090	0.0090	NA	> DL
Endosulfan II*	3/26	0.021	0.0033 - 0.056	NA	> DL
Endrin	3/32	0.013	0.00071 - 0.020	NA	2
Endrin aldehyde*	5/29	0.22	0.01 - 0.97	NA	> DL
Heptachlor	1/31	0.0055	0.0055	NA	0.008
Heptachlor epoxide*	2/30	0.012	0.0033 - 0.024	NA	0.004
Inorganics (µg/L)					
Aluminum	29/46	347	15.0 - 4,840	ND[8]-2,500	NS[7]
Arsenic*	27/46	42.6	3.9 - 126	ND-3.3	50
Barium	44/46	78.5	16.0 - 306	3.9-43.7	2,000
Cadmium*	2/46	5.6	5.2 - 6.0	ND	5
Calcium	45/45	32,502	1,170 - 93,850	ND-2,305	NS
Cobalt	10/46	32.5	8.6 - 81.0	ND	NS
Copper	2/46	6.2	1.7 - 10.6	ND	1,000
Iron*	43/46	34,774	69.9 - 100,500	ND-4,370	300
Lead	9/46	2.8	0.75 - 7.3	ND-5.0	15
Magnesium	46/46	8,116	1,080 - 34,900	709-2,295	NS
Manganese*	46/46	400	5.4 - 3,270	5.3-35.8	50
Nickel	2/46	18.6	15.3 - 22.0	ND	100
Potassium	46/46	7,526	923 - 36,900	ND-1,315	NS
Sodium	46/46	27,452	1,070 - 95,900	2,130-7,560	NS
Vanadium	4/46	6.0	1.8 - 9.0	ND	NS
Zinc	14/46	22.8	6.0 - 90.5	ND-14.0	2,100
Cyanide	1/46	28.0	28.0	NA	154
pH (units)*	37/37	5.95[2]	3.22 - 7.28	NA	6.5 - 8.5

1 Measured in both volatile and semivolatile fraction.
2 Geometric average.
3 NA - Not analyzed.
4 15A NCAC 2L.0200.
5 Asterisk next to analyte indicates exceedance of state standard.
6 > DL - Greater than detection limit. Any detection is considered an exceedance of the standard.
7 NS - No standard.
8 ND - Not detected.

FIGURE 6-3 (BACKSIDE)

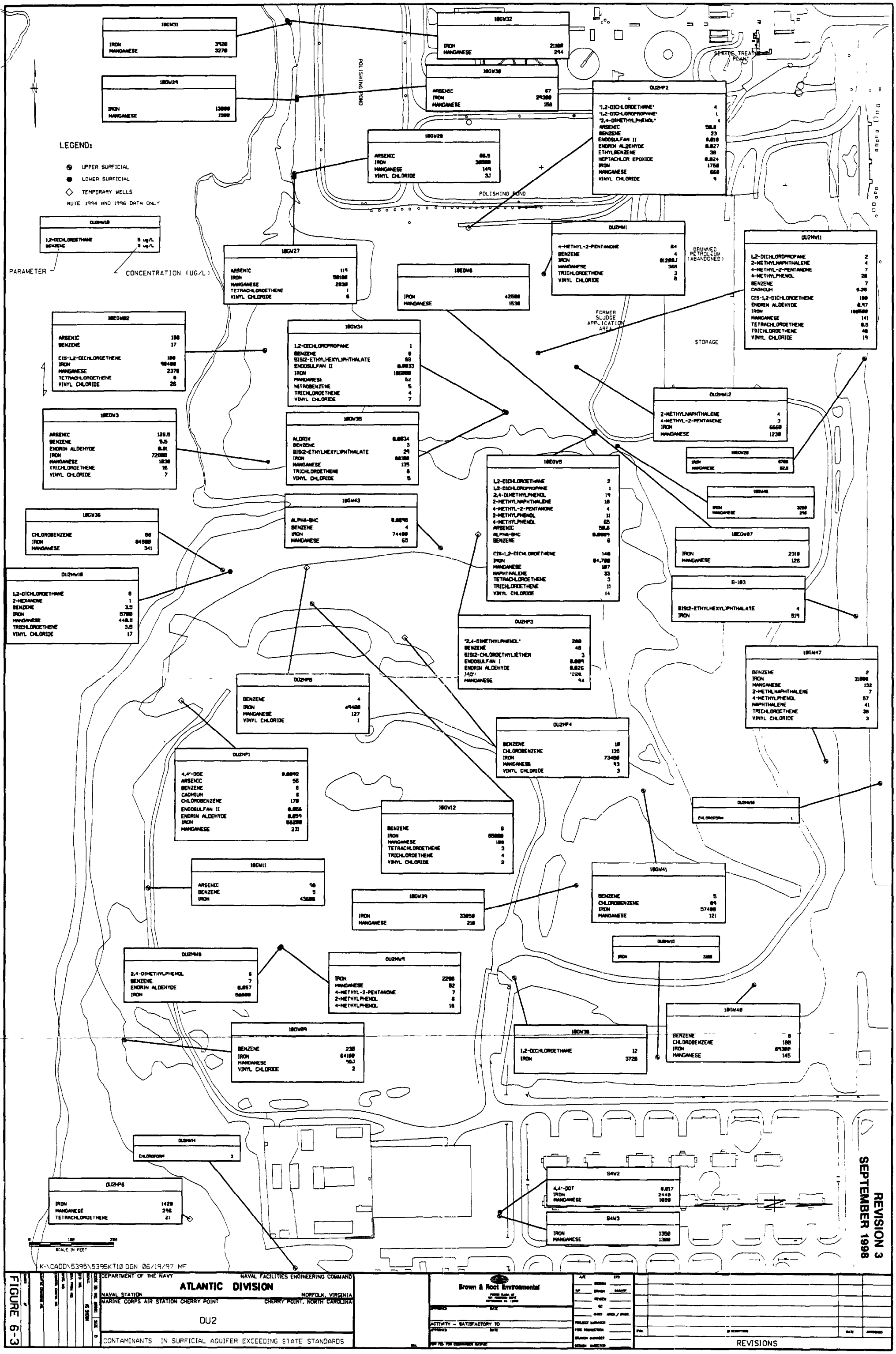

FIGURE 6-3

98274-03T052

monocyclic aromatics (chlorobenzene and dichlorobenzenes). Several items are of note in discussing the nature and extent of contamination in the surficial aquifer. First, there is widespread contamination of groundwater with organic chemicals. Those listed above are the most prevalent based on past and recent data. Second, the maximum detected concentrations of many compounds have declined over the years.

Third, although no distinct plumes are visible based on the most recent sampling event, several areas of overall contamination can be outlined as general areas of concern. These areas of concern are those in which certain contaminants exceed state and/or Federal groundwater or drinking water standards.

Benzene, TCE, and vinyl chloride were the compounds that exceeded the state groundwater quality standards most often. Chlorobenzene, chloroethane, 1,1-dichloroethane, and cis-1,2-dichloroethene were also detected frequently. The concentration of benzene over much of OU2 exceeds the state standard of 1 microgram/liter (μg/L). Within this area of general benzene contamination, three areas of solvent contamination were identified. One area is located west (downgradient) of the former sludge impoundments and extends to the south side of Turkey Gut. Another area is centered on the eastern edge of the landfill, and a third area is located in the southwest portion of OU2. This area may be associated with the fire training areas and potential use of solvents there or in the adjacent vehicle maintenance area (Site 76).

Several areas have chlorobenzene concentrations exceeding the state standard of 50 μg/L. These areas are as follows: (1) coincident with the solvent contamination area south of Turkey Gut; (2) an area in the upstream area of Turkey Gut; and (3) the areas surrounding sample OU2HP1, which is located southwest of Turkey Gut.

Metals are not significant groundwater contaminants at this site. During the most recent sampling event, only four metals (arsenic, cadmium, iron, and manganese) were found that exceeded state standards (50 μg/L, 5 μg/L, 50 μg/L, and 300 μg/L, respectively). Cobalt and vanadium were detected in several wells; however, they were not detected in background samples. Many detections of calcium, magnesium, and potassium also exceeded background concentrations.

There is no significant difference in the analytical results for wells screened in the upper and lower portions of the surficial aquifer. These results, therefore, do not indicate a great potential for nonaqueous-phase liquids at this site.

6.2.2 Yorktown Aquifer

Table 6-5 summarizes the most recent Yorktown aquifer groundwater sampling results. The analytical results for the Yorktown aquifer indicate that metals are not significant contaminants except for iron and manganese. Iron exceeded the state groundwater standard in most wells, and manganese exceeded the standard in more than 50 percent of the wells. Organic compounds were detected in low concentrations during the most recent (1994) sampling round. These include chloroform (1 and 2 μg/L), methylene chloride (3 μg/l), and bis(2-ethylhexyl)phthalate (BEHP) (25 μg/l), which are common laboratory contaminants, while BEHP is a commonly used plasticizer. However, none of these compounds were found in QA/QC blanks at levels that would affect the data. Chloroform and BEHP exceeded the state standards.

The concentrations of all metals found in the Yorktown aquifer during the most recent sampling event were below drinking water standards or state groundwater standards, except for iron and manganese. The standards for iron and manganese are based on aesthetic concerns.

6.2.3 Surface Water

Tables 6-6 and 6-7 summarize the most recent surface water sampling results for Turkey Gut and Slocum Creek, respectively. The analytical results for samples collected from Turkey Gut and Slocum Creek in 1994 indicate that the suite of compounds detected is similar to the types and classes of compounds detected in onsite groundwater. However, the surface water concentrations were generally lower than those detected in groundwater. In Turkey Gut, a sample that was located just upstream of an identifiable leachate seep (in 1985) contained benzene, chlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethane, chloroethane, cis-1,2-dichloroethene, and vinyl chloride. Most detections were 1 to 3 μg/L, although chlorobenzene was detected at a concentration of 10 μg/L in this sample. This was the only Turkey Gut sample that contained detectable concentrations of volatile organic compounds. In Slocum Creek, chloroform was consistently detected at a concentration of 1 μg/l. Cis-1,2-dichloroethene which was consistently found on site, was detected in Slocum Creek. Therefore, it can be assumed that contaminated groundwater is discharging to Slocum Creek. The sample in which cis-1,2-dichloroethene was detected is at the downgradient end of a contaminant plume emanating from the former sludge impoundment area at Site 10 that was closed in the mid-1980s.

Pesticides were detected in several surface water samples, although their presence may be related to suspended sediment material in the samples rather than actually dissolving in the surface waters. Pesticides were detected at low concentrations in a number of groundwater samples, although no plume or significant

TABLE 6-5

SUMMARY OF ANALYTICAL RESULTS - YORKTOWN AQUIFER (1994)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	NC Groundwater Standard[1]	Frequency of Detection	Average of Positive Detections	Range of Positive Detections
Volatile Organics (μg/L)				
Chloroform*[2]	0.19	2/10	1.5	1 - 2
Methylene chloride	5	1/10	3	3
Semivolatile Organics (μg/L)				
Bis(2-ethylhexyl)phthalate*	3	1/8	25	25
Inorganics (μg/L)				
Aluminum	NS[3]	6/10	198	25.0 - 936
Barium	2,000	10/10	18.1	2.0 - 44.0
Calcium	NS	10/10	61,930	49,500 - 68,600
Iron*	300	9/10	827	279 - 2,010
Lead	15	2/10	1.2	1.2
Magnesium	NS	10/10	1,700	783 - 2,380
Manganese*	50	10/10	50.9	12.0 - 90.0
Potassium	NS	10/10	2,238	858 - 7,510
Sodium	NS	10/10	10,409	1,280 - 32,000
Zinc	2,100	1/10	10.0	10.0
pH (units)*	6.5 - 8.5	10/10	7.42[4]	6.99 - 8.59

1 15A NCAC 2L.0200.
2 Asterisk indicates exceedance of state standard.
3 NS - No standard.
4 Geometric average.

TABLE 6-6

SUMMARY OF ANALYTICAL RESULTS - TURKEY GUT SURFACE WATER (1994)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections	NC Class C Standard/ Criteria[4]
Volatile Organics (μg/L)				
Benzene	1/4	1	1	71.4
Chlorobenzene	1/4	10	10	21,000
1,4-Dichlorobenzene[1]	1/8	2	2	2,600
1,1-Dichloroethane	1/4	2	2	19.8
Chloroethane	1/4	3	3	860
cis-1,2-Dichloroethene	1/4	1	1	7.0
Vinyl chloride	1/4	1	1	525
Semivolatile Organics (μg/L)				
Bis(2-ethylhexyl)phthalate*	2/4	5	4 - 6	5.9
Pesticides/PCBs (μg/L)				
gamma-BHC (Lindane)	2/4	0.0049	0.0016 - 0.0081	0.01
4,4'-DDD*	1/4	0.028	0.028	0.00084
Heptachlor epoxide*	1/4	0.0019	0.0019	0.00011
Inorganics (μg/L)				
Aluminum*	3/4	380	29.0 - 1,010	87
Arsenic	1/4	2.95	2.95	50
Barium	4/4	57.1	40.5 - 90.0	1,400
Calcium*	4/4	63,750	21,400 - 135,000	7,300
Iron*	4/4	4,391	1,435 - 11,600	1,000
Lead	1/4	7.5	7.5	25
Magnesium*	4/4	102,719	3,125 - 393,000	200
Manganese*	4/4	268	80.5 - 458	100
Potassium*	4/4	33,176	1,840 - 123,000	30,000
Sodium*	4/4	766,645	3,170 - 3,030,000	400,000
Zinc	1/4	17.0	17.0	50
pH (units)	4/4	6.52[2]	6.01 - 6.95	6 - 9

TABLE 6-6 (Continued)
SUMMARY OF ANALYTICAL RESULTS - TURKEY GUT SURFACE WATER (1994)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections	NC Class C Standard/ Criteria[4]
Inorganics - Filtered (μg/L)				
Antimony	1/4	11.5	11.5	4,300
Barium	4/4	54.5	39.0 - 86.0	1,400
Calcium*	4/4	64,550	22,100 - 139,000	7,300
Copper*	2/4	16.1	7.25 - 25.0	7
Iron*	3/4	2,526	727 - 5,580	1,000
Magnesium*	4/4	101,246	3,115 - 387,000	200
Manganese*	4/4	232	71.5 - 447	100
Potassium*	4/4	31,430	1,890 - 116,000	30,000
Sodium*	4/4	796,685	3,200 - 3,150,000	400,000
Zinc	1/4	12.0	12.0	50

1 Measured in both volatile and semivolatile fractions.
2 Geometric average.
3 NA - Not applicable.
4 NCDENR, 1997. Asterisk next to analyte indicates exceedance of standard.

TABLE 6-7

SUMMARY OF ANALYTICAL RESULTS - SLOCUM CREEK SURFACE WATER (1994)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections	NC Class SC Standards/ Criteria[3]
Volatile Organics (µg/L)				
Acetone	1/1	3	3	500
cis-1,2-Dichloroethene	2/3	1.5	1 - 2	NS[4]
Chloroform	3/3	1	1	470
Pesticides/PCBs (µg/L)				
4,4'-DDD*	3/3	0.033	0.027 - 0.039	0.00084
Inorganics (µg/L)				
Barium	3/3	51.0	37.0 - 60.0	1,400
Calcium*	3/3	134,000	132,000 - 135,000	7,300
Copper*	1/3	28.0	28.0	3
Iron	2/3	132	106 - 158	NS
Magnesium*	3/3	396,000	379,000 - 407,000	200
Manganese*	3/3	383	350 - 432	100
Potassium*	3/3	120,333	116,000 - 123,000	30,000
Sodium*	3/3	3,073,333	2,950-000 - 3,150,000	400,000
pH (units)	3/3	7.47[1]	7.55 - 7.87	6 - 9
Inorganics - Filtered (µg/L)				
Antimony	1/3	7.4	7.4	4,300
Barium	3/3	32.0	28.0 - 37.0	1,400
Calcium*	3/3	140,333	138,000 - 144,000	7,300
Copper*	3/3	27.7	23.0 - 37.0	3
Magnesium*	3/3	401,667	395,000 - 414,000	200
Manganese	2/3	6.0	6.0	100

TABLE 6-7 (Continued)
SUMMARY OF ANALYTICAL RESULTS - SLOCUM CREEK SURFACE WATER (1994)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections	NC Class SC Standards/ Criteria[3]
Potassium*	3/3	119,000	116,000 - 124,000	30,000
Sodium*	3/3	3,140,000	3,090,000 - 3,210,000	400,000
Zinc	1/3	7.0	7.0	86

1 Geometric average.
2 NA - Not applicable.
3 NCDENR, 1997. Asterisk next to analyte indicates exceedance of standard.
4 NS - No standard.

soil source area could be identified that could result in the presence of these pesticides in Turkey Gut or Slocum Creek. The source of these pesticides is most likely the prior or current application of these materials throughout the watershed, followed by runoff.

It is notable that manganese, which was a prevalent groundwater contaminant at concentrations that exceeded state groundwater standards, was also found in Turkey Gut. This is an additional indication of discharge of shallow groundwater to Turkey Gut. Manganese was also detected in Slocum Creek.

There is no general pattern or trend in contaminant distribution in either Turkey Gut or Slocum Creek.

6.3 SEDIMENT AND SEEPS

6.3.1 Sediment

Tables 6-8 and 6-9 summarize sediment sampling results for Turkey Gut and Slocum Creek, respectively. Sediment analytical results indicate that pesticides and metals are the most frequently detected analytes. A wide variety of pesticides was found in Turkey Gut. In Turkey Gut, the pesticides were found generally in an upstream sample or in a sample collected from near the mouth of Turkey Gut. Some, but not all, of the identified compounds were detected in surface soil samples. Some, but not all, of the pesticides detected in Slocum Creek were also detected in surface soil samples. It is not known whether the site is contributing to the presence of pesticides or whether such presence is a result of current or past use of pesticides at the Air Station.

The concentrations of metals in sediment in Slocum Creek and Turkey Gut do not appear to indicate the presence of a major onsite source area. Many of the metals are found at concentrations within approximately two times the background soil concentrations. Although this comparison is not totally valid (i.e., soils are not the same as sediments), the fact still has credence in identifying whether onsite soils may be contributing to the observed sediment contamination. The maximum concentrations of individual metals were found at various Turkey Gut sample locations. Maximum concentrations in Slocum Creek were generally detected in the most downstream location. No upgradient or upslope areas could be identified as potential sources of these metals in Slocum Creek.

6.3.2 Leachate Seeps

The earliest leachate seep water and sediment samples were collected and analyzed in 1985 and 1987. Additional leachate seep samples were collected in 1995. Samples were collected of surface water (if

TABLE 6-8

SUMMARY OF ANALYTICAL RESULTS - TURKEY GUT SEDIMENT
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections
Volatile Organics (µg/kg)			
2-Butanone	3/10	191	9.25 - 540
Ethylbenzene	1/10	11	11
Xylenes (total)	2/10	24	5 - 43
1,1-Dichloroethane	1/10	19	19
Chloroethane	1/10	75	75
Carbon disulfide	1/8	20	20
Semivolatile Organics (µg/kg)			
Di-n-butylphthalate	4/6	494	350 - 640
Pesticides/PCBs (µg/kg)			
alpha-Chlordane	4/4	6.67	0.36 - 25
gamma-Chlordane	4/4	3.1	0.34 - 8.8
4,4'-DDD	3/5	1.48	0.45 - 3.4
4,4'-DDE	3/5	0.87	0.42 - 1.4
4,4'-DDT	1/6	0.20	0.20
Dieldrin	3/6	7.9	0.52 - 22
Endosulfan II	1/6	0.24	0.24
Endrin aldehyde	1/6	0.40	0.40
Endrin ketone	1/4	1.2	1.2
Heptachlor	2/6	0.14	0.13 - 0.15
Heptachlor epoxide	1/6	16	16
Inorganics (mg/kg)			
Aluminum	8/8	7230	1,630 - 11,100
Antimony	2/9	15.0	10.0 - 20.0
Arsenic	7/9	3.3	1.2 - 7.2
Barium	8/8	30.7	12.6 - 92.1
Beryllium	1/9	0.20	0.20
Cadmium	2/9	2.5	1.4 - 3.6
Calcium	8/8	4208	348 - 12,000
Chromium	9/9	11.1	2.0 - 24.6
Cobalt	1/7	2.3	2.3

TABLE 6-8 (Continued)
SUMMARY OF ANALYTICAL RESULTS - TURKEY GUT SEDIMENT
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections
Copper	6/9	4.0	2.0 - 6.6
Iron	8/8	8480	1,930 - 18,200
Lead	8/10	22.5	6.55 - 52.5
Magnesium	8/8	494	155 - 930
Manganese	8/8	45.1	6.4 - 182
Mercury	2/9	0.14	0.10 - 0.17
Nickel	2/10	9.5	4.3 - 14.7
Potassium	7/7	400	123 - 679
Selenium	1/9	0.70	0.70
Sodium	6/8	304	40.7 - 1,090
Vanadium	8/8	15.9	4.8 - 26.7
Zinc	10/10	23.5	2.0 - 73.1

TABLE 6-9

SUMMARY OF ANALYTICAL RESULTS - SLOCUM CREEK SEDIMENT
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections
Volatile Organics (µg/kg)			
2-Butanone	1/7	13	13
Chlorobenzene	1/7	61	61
Chloromethane	1/7	16	16
Semivolatile Organics (µg/kg)			
Bis(2-ethylhexyl)phthalate	1/5	430	430
Di-n-butylphthalate	3/5	430	190 - 800
Pesticides/PCBs (µg/kg)			
alpha-Chlordane	1/3	1.5	1.5
4,4'-DDD	1/4	2.7	2.7
4,4'-DDE	1/5	2.8	2.8
Inorganics (mg/kg)			
Aluminum	5/5	2,289	382 - 8,760
Antimony	1/7	10.6	10.6
Arsenic	5/7	8.1	0.30 - 32.7
Barium	5/5	10.6	1.1 - 35.8
Calcium	5/5	1,732	136 - 6,540
Chromium	3/7	21.7	1.7 - 57.5
Cobalt	1/5	3.4	3.4
Copper	2/7	10.9	3.9 - 17.9
Iron	5/5	11,122	932 - 32,600
Lead	4/7	13.5	1.2 - 37.7
Magnesium	4/5	1,036	93.7 - 2,650
Manganese	5/5	111	3.3 - 394
Mercury	1/7	0.60	0.60
Nickel	1/7	3.0	3.0
Potassium	3/5	444	93.6 - 956
Selenium	1/7	0.89	0.89
Sodium	5/5	3,006	155 - 8,250
Vanadium	2/5	3.5	1.7 - 5.2
Zinc	6/7	26.1	1.0 - 113

present) or sediment (if no surface water present) from near the four locations sampled between 1985 and 1987, along with a water sample from a new location. One of the water samples was from a leachate seep/spring at the toe of the Site 10 landfill, and two were from areas of ponded surface water.

Table 6-10 summarizes the most recent leachate seep sampling results. Based on the 1995 results, the actual leachate seep contained several volatile organic compounds (2 μg/L of benzene, 5 μg/L of chloroethane, and 3 μg/L of vinyl chloride) that were also detected in the surficial aquifer, although at higher concentrations. One of the areas of ponded water contained the only other detections of organic chemicals (xylenes at 2 μg/L and several pesticides ranging from 0.0625 μg/L to 0.17 μg/L).

Based on the 1995 results, the leachate seep contained the highest concentrations of all metals (except thallium). In several cases, the concentrations of metals in this sample exceeded the maximum detections in the surficial aquifer. These metals included antimony, cadmium, chromium, copper, lead, nickel, selenium, and zinc. For all other metals, the concentrations in groundwater exceed the leachate water concentrations. Many of the metals (cadmium, iron, and manganese) were present at concentrations that exceeded State groundwater standards and/or Federal drinking water standards. The low flow rate of this seep makes it unlikely that leachate water would migrate to groundwater and cause an exceedance of a groundwater standard. In addition, this leachate seep may be an area of groundwater discharge.

The sediment samples collected in 1995 from previously identified (but visibly dry at the time of sampling) leachate seep locations were similar in concentration to surface soil samples. The analytical results are included with surface soil (Table 6-1). Only a few organic compounds were detected (monocyclic aromatics, trihalomethanes, phthalate esters, and pesticides) at low concentrations. The organic compounds detected at the highest concentrations were 2,4-dinitrophenol (850 μg/kg), 4-nitrophenol (850 μg/kg), 4,4'-DDE (69 μg/kg), di-n-octylphthalate (67 μg/kg), and toluene (42 μg/kg). The concentrations of all other organics ranged from 7.6 μg/kg (endosulfan I) to 25 μg/kg (alpha-chlordane).

The concentrations of metals in these two leachate seep sediment samples were also similar to those reported for surface soil. However, some metals were found at higher concentrations while others were found at lower concentrations. Some of the more notable metals detections include arsenic (17.1 mg/kg), lead (76.5 mg/kg), and zinc (80.8 mg/kg).

TABLE 6-10

SUMMARY OF ANALYTICAL RESULTS - LEACHATE SEEP WATER (1995)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections
Volatile Organics (μg/L)			
Benzene	1/3	2	2
Xylenes	1/3	2	2
Chloroethane	1/3	5	5
Vinyl chloride	1/3	3	3
Semivolatile Organics (μg/L)			
Butylbenzylphthalate	1/3	10	10
Pesticides/PCBs (μg/L)			
Aldrin	1/3	0.0625	0.0625
gamma-BHC	1/3	0.0725	0.0725
4,4'-DDT	1/3	0.17	0.17
Dieldrin	1/3	0.155	0.155
Endrin	1/3	0.165	0.165
Heptachlor	1/3	0.0775	0.0775
Inorganics (μg/L)			
Aluminum	3/3	721.8	360.5 - 1,310
Antimony	1/3	9.4	9.4
Arsenic	3/3	2.8	2.2 - 3.9
Barium	3/3	31.2	5.2 - 76.8
Cadmium	3/3	9.4	0.8 - 24.2
Calcium	3/3	16,185	3,705 - 36,500
Chromium	3/3	3.8	0.85 - 5.6
Cobalt	1/3	6.5	6.5
Copper	2/3	36.0	9.3 - 62.6
Iron	3/3	13,991	558 - 40,400

TABLE 6-10 (Continued)
SUMMARY OF ANALYTICAL RESULTS - LEACHATE SEEP WATER (1995)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Frequency of Detection	Average of Positive Detections	Range of Positive Detections
Lead	1/3	24.1	24.1
Magnesium	3/3	1,401.7	681 - 2,580
Manganese	3/3	212.3	62.5 - 494
Nickel	3/3	33.3	0.85 - 97.9
Potassium	3/3	3,033.3	1,860 - 4,470
Selenium	2/3	2.45	2.3 - 2.6
Sodium	3/3	2,926.7	1,240 - 5,640
Thallium	1/3	1.95	1.95
Vanadium	3/3	3.5	2.15 - 6.0
Zinc	3/3	299.2	26.3 - 813
pH	3/3	6.11[1]	6.09 - 6.15

1 Geometric average.
2 NA - Not applicable.

6.3.3 Polishing Pond Sediment

Table 6-11 summarizes the polishing pond sampling results. Eight sediment and soil samples were collected from the polishing ponds in 1994. The uppermost samples were collected from the pond sediment, and the deeper samples were collected from the underlying natural soil material. The data indicate that the sediments in the ponds contain a number of organic chemicals, whereas the underlying soils are fairly free of organic contamination. For example, pond sediment contains ketones, monocyclic aromatics, phthalate esters, PAHs, and pesticides at concentrations ranging from 0.063 μg/kg (gamma-BHC) to 13,000 μg/kg [bis(2-ethylhexyl)phthalate]. The underlying natural soil material contains chloroform (4 μg/kg), bis(2-ethylhexyl)phthalate (130 μg/kg), di-n-butylphthalate (255 μg/kg), alpha-chlordane (0.1 μg/kg), and heptachlor (up to 0.14 μg/kg). In general, the pond sediments contain higher concentrations of metals than the underlying soils.

TABLE 6-11

SUMMARY OF ANALYTICAL RESULTS - POLISHING POND SEDIMENT/SOIL
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Sediments[1]			Soil[2]		
	Concentration Range	Average of Positive Detections	Frequency of Detection	Concentration Range	Average of Positive Detections	Frequency of Detection
Volatile Organics (μg/kg)						
Acetone	1,300	1,300	1/4	ND[3]	--	--
2-Butanone	11 - 80	34.3	3/4	ND	--	--
Toluene	26	26	1/4	ND	--	--
Ethylbenzene	42	42	1/4	ND	--	--
Xylenes	44	44	1/4	ND	--	--
Chloroform	ND	--	--	4	4	1/4
Carbon disulfide	31	31	1/4	ND	--	--
Semivolatile Organics (μg/kg)						
Bis(2-ethylhexyl)phthalate	120 - 13,000	3,590	4/4	130	130	1/4
Di-n-butylphthalate	180 - 350	250	4/4	200 - 290	255	4/4
Phenol	260	260	1/4	ND	--	--
Fluoranthene	250	250	1/4	ND	--	--
2-Methylnaphthalene	130	130	1/4	ND	--	--

TABLE 6-11 (Continued)
SUMMARY OF ANALYTICAL RESULTS - POLISHING POND SEDIMENT/SOIL
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Sediments[1]			Soil[2]		
	Concentration Range	Average of Positive Detections	Frequency of Detection	Concentration Range	Average of Positive Detections	Frequency of Detection
Pesticides/PCBs (µg/kg)						
Aldrin	0.28 - 3.8	2.0	2/4	ND	--	--
gamma-BHC (Lindane)	0.063 - 1.2	0.63	2/4	ND	--	--
alpha-Chlordane	0.66 - 15	7.8	2/4	0.10	0.10	1/4
gamma-Chlordane	2.6	2.6	1/3	ND	--	--
4,4'-DDD	13	13	1/2	ND	--	--
4,4'-DDE	0.19 - 16	5.5	3/3	ND	--	--
Dieldrin	0.53 - 9.4	5.0	2/4	ND	--	--
Endosulfan I	5.1	5.1	1/4	ND	--	--
Heptachlor	0.11	0.11	1/3	0.068 - 0.14	0.099	3/3
Methoxychlor	0.44	0.44	1/3	ND	--	--
Inorganics (mg/kg)						
Aluminum	5,330 - 9.810	8,040	4/4	2,920 - 4/410	3,580	4/4
Arsenic	2.3 - 3.3	2.8	2/4	1.3 - 2.3	1.9	4/4
Barium	10.2 - 25.6	15.8	4/4	5.0 - 7.2	5.75	4/4
Beryllium	0.34	0.34	1/4	ND	--	--

TABLE 6-11 (Continued)
SUMMARY OF ANALYTICAL RESULTS - POLISHING POND SEDIMENT/SOIL
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Sediments[1]			Soil[2]		
	Concentration Range	Average of Positive Detections	Frequency of Detection	Concentration Range	Average of Positive Detections	Frequency of Detection
Cadmium	1.7 - 41.	2.9	2/4	ND	--	--
Calcium	319 - 1,180	636	4/4	73.3 - 295	185	4/4
Chromium	14.0 - 78.5	32.4	4/4	3.8 - 11.7	7.55	4/4
Copper	2.3 - 17.4	6.7	4/4	1.2 - 1.6	1.47	3/4
Iron	3,340 - 14,500	8,312	4/4	2,690 - 6,720	4,368	4/4
Lead	3.2 - 7.1	5.0	4/4	1.9 - 3.7	2.4	4/4
Magnesium	264 - 514	417.4	4/4	148 - 220	184	4/4
Manganese	9.5 - 20.4	14.2	4/4	4.3 - 10.2	6.5	4/4
Mercury	0.12 - 0.85	0.485	2/4	ND	--	--
Nickel	10.3	10.3	1/4	ND	--	--
Potassium	328 - 616	453	4/4	244 - 262	235.5	4/4
Selenium	0.18 - 0.26	0.22	2/4	ND	--	--
Silver	0.97 - 4.1	2.54	2/4	ND	--	--
Vanadium	14.8 - 36.8	23.3	4/4	8.5 - 13.0	9.9	4/4

TABLE 6-11 (Continued)
SUMMARY OF ANALYTICAL RESULTS - POLISHING POND SEDIMENT/SOIL
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	Sediments[1]			Soil[2]		
	Concentration Range	Average of Positive Detections	Frequency of Detection	Concentration Range	Average of Positive Detections	Frequency of Detection
Zinc	7.08 - 55.3	27.9	3/4	ND	--	--
Cyanide	1.8	1.8	1/4	ND	--	--

1 Includes sample OU2SD08-1012, OU2SD09-1012, OU2SD10-1012, OU2SD10-1012-D, and OU2SD11-1012. Duplicate sample results are averaged and counted as one sample.
2 Includes samples OU2SD08-1214, OU2SD09-1214, OU2SD10-1214, and OU2SD11-1214.
3 ND - Not Detected.

7.0 CONTAMINANT FATE AND TRANSPORT

The primary contaminants at Operable Unit No. 2 are volatile organic compounds in soil and shallow groundwater (surficial aquifer). Volatile organic chemicals are typically considered to be fairly soluble and have a low capacity for retention to soil organic carbon. Therefore, they are the organic compounds most likely to be detected in groundwater. These types of chemicals may migrate through the soil column to groundwater as infiltrating precipitation solubilizes them. Some portion of these chemicals is retained by the unsaturated soil, but most will continue migrating downward until they reach the water table. At that time, migration is primarily lateral with the hydraulic gradient at a rate determined by the aquifer seepage velocity and chemical retardation. Again, some portion of the chemical may be retained by the saturated soil.

Several of these compounds have specific gravities less than that of water (e.g., benzene, xylenes). These compounds are typically found in fuels, and if a large enough spill occurs (including using gasoline, etc. as a fuel), these compounds may move through the soil column as a bulk liquid until they reach the water table. There, instead of going into solution, the majority of the release may remain as a discrete fuel layer on the water-table surface, with some of the material being dissolved at the water/fuel interface. No floating fuel product was observed in any of the monitoring wells at OU2. The water table over much of the study area is less than 15 feet deep.

Pesticides were widely used at the Air Station. Many of the compounds detected are no longer licensed for general sale and use in the United States. Therefore, it is assumed that much of what was detected in the soil and sediments is representative of past application for insect control. Pesticides as a class of compounds are not considered to be very mobile in the environment. These chemicals, upon application or disposal, tend to remain affixed to soil particles. Migration of pesticides occurs primarily by wind or water erosion. Concentrations of pesticides are generally below 50 μg/kg, with a few exceptions such as detections of DDT and DDD in subsurface soils.

8.0 SUMMARY OF SITE RISKS

8.1 BASELINE HUMAN HEALTH RISK ASSESSMENT

The baseline risk assessment provides the basis for taking action and indicates the exposure pathways that need to be addressed by remedial action. It serves as the baseline indicating what risks could exist if no action were taken at OU2. This section of the ROD reports the results of the baseline risk assessment conducted for OU2.

8.1.1 Chemicals of Potential Concern

A human health risk assessment was conducted for Operable Unit 2 using the following current USEPA risk assessment guidance and Region IV supplements:

- Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A) (USEPA, December 1989).
- Exposure Factors Handbook (USEPA, May 1989).
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (USEPA, March 25, 1991).
- Baseline Risk Assessment Guidance (USEPA Region IV, April 4, 1991).
- Dermal Exposure Assessment: Principles and Applications, Interim Report (USEPA, January 1992).
- Supplement to RAGS: Calculating the Concentration Term (USEPA, May 1992).
- Supplement to RAGS: Region IV Bulletins (1-5) - Human Health Risk Assessment (USEPA Region IV, November 1995).

The first step in the risk assessment was to develop a list or group of chemicals referred to as chemicals of potential concern (COPCs) for each medium sampled. Contaminant concentrations were then compared to risk-based screening concentrations, background concentrations, and groundwater and surface water standards. The risk-based concentrations were calculated to correspond to an individual chemical

incremental lifetime cancer risk of 1E-6 (1×10^{-6}, or a one-in-one-million risk) and a Hazard Index of 0.1 for specified, routine exposure. Residential exposure levels were used for soil and sediment. Risk-based concentrations for residential use of groundwater were used for screening groundwater and surface water contaminants.

Any COPC that is carried through the risk assessment process and has an incremental lifetime cancer risk (ILCR) greater than 1E-6 or HI greater than 0.1 for any of the exposure scenarios is referred to as a chemical of concern (COC). Contaminants that exceed a groundwater or surface water standard are also retained as COCs.

Essential elements may be screened out of a risk assessment if it is shown that concentrations detected are not associated with adverse health effects or do not exceed as groundwater or surface water standard. Therefore, the following nutrients were eliminated: calcium, magnesium, potassium, and sodium.

COPCs were developed for surface soil (less than 2 feet deep), all soils to a depth of 10 feet (the maximum assumed depth of intrusive activities [e.g., excavation, utility lines]), groundwater, stream surface water and sediment, leachate seeps, and Site 46 polishing pond sediment. Table 8-1 identifies the COPCs for OU2.

8.1.2 Exposure Assessment

Whether a chemical is actually a concern to human health depends upon the likelihood of exposure (i.e., whether the exposure pathway is currently complete or could be complete in the future). A complete exposure pathway (a sequence of events leading to contact with a chemical) is defined by the following four elements:

- Source and mechanism of release.
- Transport medium (e.g., surface water, air) and mechanism of migration through the medium.
- Presence or potential presence of receptor at the exposure point.
- Route of exposure (ingestion, inhalation, dermal absorption).

If all four elements are present, the pathway is considered complete.

A conceptual site model was developed for OU2 to define potential receptors and the routes by which they are likely to be exposed. Figure 8-1 represents the conceptual site model used to evaluate potential receptors for Operable Unit 2. Identified receptors under current land use conditions included maintenance workers, trespassers, and recreational users of Slocum Creek. In addition, potential future land use

TABLE 8-1

MEDIA-SPECIFIC CHEMICALS OF POTENTIAL CONCERN (COPCs)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Surface Soil (0 to 2 Feet)	All Soil (0 to 10 Feet)	Groundwater	Leachate Seeps	Surface Water	Sediment	Polishing Pond Sediment
Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Indeno(1,2,3-cd)pyrene Aroclor-1260 Aluminum Antimony Arsenic Beryllium Cadmium Chromium Iron Manganese Thallium	Arsenic Cadmium Lead	**Surficial Aquifer:** 1,1-Dichloroethene 1,2-Dichloroethane 1,2-Dichloropropane 2-Butanone 2-Hexanone 4-Methyl-2-pentanone Benzene Chlorobenzene Chloroform Chloroethane cis-1,2-Dichloroethene Ethylbenzene Tetrachloroethene Toluene Trichloroethene Vinyl chloride 1,2-Dichlorobenzene 1,4-Dichlorobenzene 2-Methylnaphthalene 2-Methylphenol 4-Methylphenol 2,4-Dimethylphenol Bis(2-chloroethyl)ether Bis(2-ethylhexyl)phthalate Naphthalene Nitrobenzene 4,4'-DDE 4,4'-DDT Aldrin	Benzene Chloroethane Vinyl chloride 4,4'-DDT Aldrin gamma-BHC Dieldrin Heptachlor Antimony Arsenic Cadmium Iron Lead Manganese Nickel Thallium	**Turkey Gut:** Bis(2-ethylhexyl)phthalate 4,4'-DDD Heptachlor epoxide Arsenic **Slocum Creek:** 4,4'-DDD	**Turkey Gut:** Aluminum Antimony Arsenic Beryllium Iron Manganese **Slocum Creek:** Aluminum Antimony Arsenic Chromium Iron Manganese	None

TABLE 8-1 (Continued)
MEDIA-SPECIFIC CHEMICALS OF POTENTIAL CONCERN (COPCs)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Surface Soil (0 to 2 Feet)	All Soil (0 to 10 Feet)	Groundwater	Leachate Seeps	Surface Water	Sediment	Polishing Pond Sediment
		Surficial Aquifer: (Continued) alpha-BHC gamma-BHC Endosulfan I Endosulfan II Endrin Aldehyde Heptachlor Heptachlor epoxide Aluminum Arsenic Barium Cadmium Iron Manganese **Yorktown Aquifer:** Chloroform Bis(2-ethylhexyl)phthalate Iron Manganese				

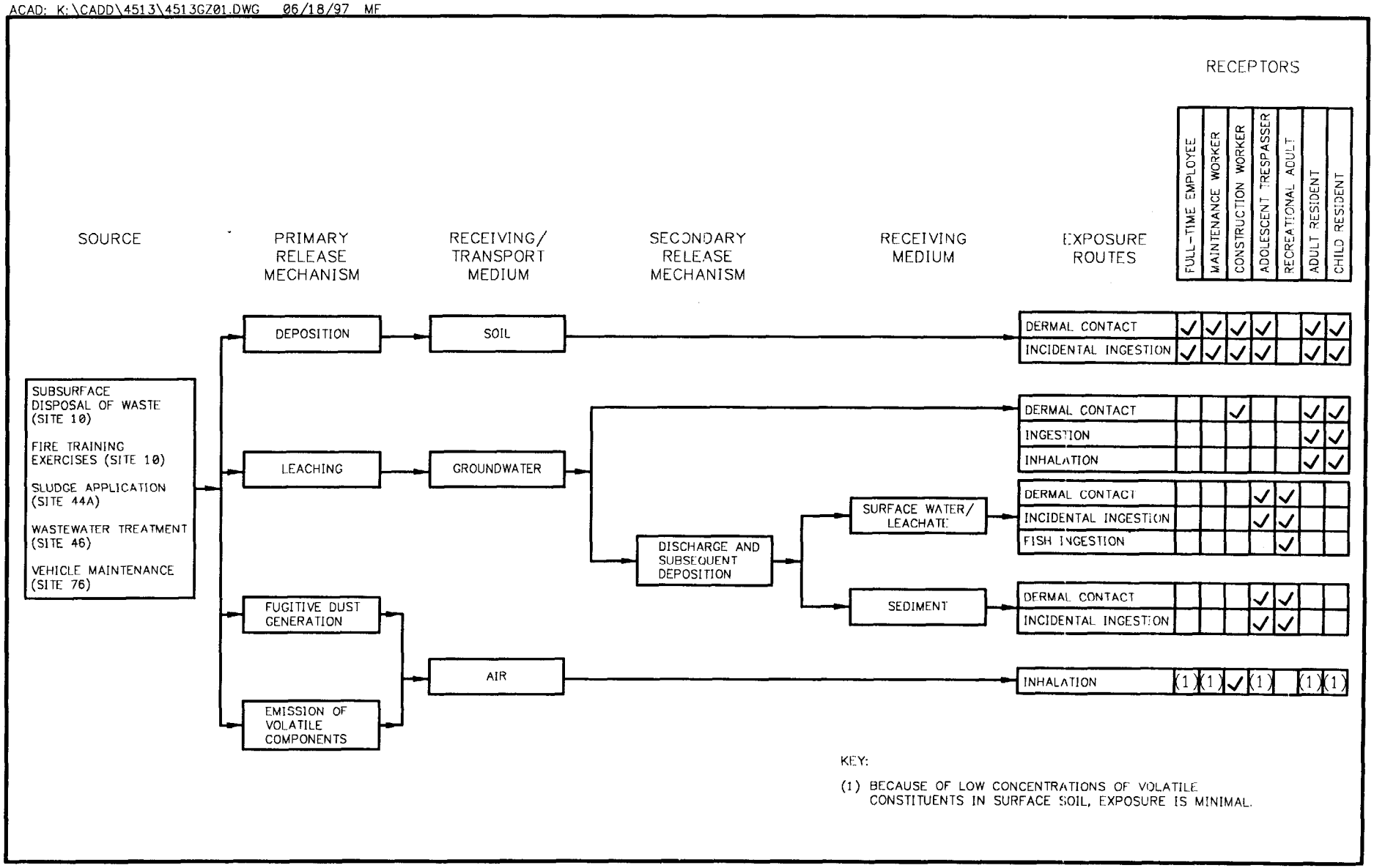

FIGURE 8-1

CONCEPTUAL SITE MODEL
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Brown & Root Environmental

conditions were also considered for residents, full-time employees, and construction workers. Maintenance workers and full-time employees were assumed to be exposed only to surface soil via direct contact during routine onsite activities. Trespassers were assumed to come into direct contact with surface soil, surface water, leachate seeps, and sediment. Recreational users were assumed to be exposed to surface water and sediment via direct contact. In addition, ingestion of fish was also considered. Under future land use conditions, construction workers represent potential receptors who could be exposed via direct contact to soils to a depth of perhaps 10 feet. Additional exposure routes considered for construction workers are direct contact with groundwater in the bottom of an excavation and inhalation of fugitive dust generated when the soil is disturbed. Future potential residents are assumed to be exposed to surface soil and groundwater via direct contact.

Two scenarios that were not considered to be applicable to OU2 are inhalation of volatile emissions or fugitive dust under current land use conditions. Volatile emissions are considered to be minimal, as only low concentrations of volatile organic compounds were detected in the surface soil. Fugitive dust is not considered because the site is currently well vegetated.

Exposure concentrations are based on a statistical development of the upper 95 percent confidence limit on the data set. There are many instances where, with isolated detections of high concentrations among many lower concentrations, the Upper Confidence Level (UCL) can exceed the maximum detected concentrations. In these cases, the maximum detection is used as the exposure concentration. Since this was the case for many COPCs in most media at OU2, the risk assessment is considered to be extremely conservative. Exposure concentrations used to calculate human health risks are summarized in Table 8-2. Parameters used to estimate potential exposures for current and future land use receptors are summarized in Tables 8-3 and 8-4, respectively.

8.1.3 Toxicity Assessment

A cancer slope factor (CSF) and a reference dose (RfD) are applied to estimate risk of cancer from an exposure and the potential for noncarcinogenic effects to occur from exposure.

CSFs have been developed by USEPAs Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic COPCs. CSFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of risks calculated from the CSF. Use of this approach makes underestimations of the actual cancer risk highly unlikely. CSFs are derived from the

TABLE 8-2

EXPOSURE CONCENTRATIONS FOR CHEMICALS OF POTENTIAL CONCERN (COPCs)[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	Surface Soil (0 to 2 feet) (mg/kg)	All Soil (0 to 10 feet) (mg/kg)	Groundwater (mg/L)		Surface Water (mg/L)			Sediment (mg/kg)	
			Surficial Aquifer	Yorktown Aquifer	Slocum Creek	Turkey Gut	Leachate Seeps	Slocum Creek	Turkey Gut
1,1-Dichloroethene	--[2]	--	0.00077	--	--	--	--	--	--
1,2-Dichloroethane	--	--	0.00097	--	--	--	--	--	--
1,2-Dichloropropane	--	--	0.00083	--	--	--	--	--	--
2-Butanone	--	--	0.020	--	--	--	--		
2-Hexanone	--	--	0.001	--	--	--	--		
4-Methyl-2-pentanone	--	--	0.005	--	--	--	--		
Benzene	--	--	0.012	--	--	--	0.002[3]	--	--
Chlorobenzene	--	--	0.072	--	--	--	-	--	--
Chloroethane	--	--	0.0087	--	--	--	0.005[3]		
Chloroform	--	--	0.00087	0.002[3]		--	--	--	--
cis-1,2-Dichloroethene	--	--	0.015	--	--	--	--	--	--
Ethylbenzene	--	--	0.0024	--	--	--	--		
Methylene chloride	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	0.0015	--	--	--	--	--	--
Toluene	--	--	0.0055	--	--	--	--	--	--
Trichloroethene	--	--	0.0035	--	--	--	--	--	--
Vinyl chloride	--	--	0.0048	--	--	--	0.003[3]	--	--
1,2-Dichlorobenzene	--	--	0.0029	--	--	--	--	--	--
1,4-Dichlorobenzene	--	--	0.0082	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	0.010	--	--	--	--	--	--

TABLE 8-2 (Continued)
EXPOSURE CONCENTRATIONS FOR CHEMICALS OF POTENTIAL CONCERN (COPCs)[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	Surface Soil (0 to 2 feet) (mg/kg)	All Soil (0 to 10 feet) (mg/kg)	Groundwater (mg/L)		Surface Water (mg/L)			Sediment (mg/kg)	
			Surficial Aquifer	Yorktown Aquifer	Slocum Creek	Turkey Gut	Leachate Seeps	Slocum Creek	Turkey Gut
2-Methylnaphthalene	--	--	0.0057	--	--	--	--	--	--
2-Methylphenol	--	--	0.0054	--	--	--	--	--	--
4-Methylphenol	--	--	0.010	--	--	--	--	--	--
Benzo(a)anthracene	0.160[3]	--	--	--	--	--	--		
Benzo(a)pyrene	0.240[3]	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	0.170[3]	--	--	--	--	--	--		
Benzo(k)fluoranthene	0.160[3]	--	--	--	--	--	--		
Bis(2-chloroethyl)ether	--	--	0.003[3]	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	--	--	0.011	0.0188	--	0.006[3]	--	--	--
Chrysene	0.220[3]	--	--	--	--	--	--		
Indeno(1,2,3-cd)pyrene	0.140[3]	--	--	--	--	--	--		
Naphthalene	--	--	0.0081	--	--	--	--	--	--
Nitrobenzene	--	--	0.005[3]	--	--	--	--	--	--
4,4'-DDD	--	--	--	--	0.000039[3]	0.00028[3]	--	--	--
4,4'-DDE	--	--	0.000055	--	--	--	--	--	--
4,4'-DDT	--	--	0.00001[3]	--	--	--	0.00017[3]	--	--
Aldrin	--	--	0.0000034[3]	--	--	--	0.0000625[3]	--	--
α-BHC	--	--	0.0000098[3]	--	--	--	--	--	--
γ-BHC	--	--	0.000027	--	--	--	0.0000725[3]	--	--
Dieldrin	--	--	--	--	--	--	0.000155[3]	--	--
Endosulfan II	--	--	0.00005[3]	--	--	--	--	--	--

TABLE 8-2 (Continued)
EXPOSURE CONCENTRATIONS FOR CHEMICALS OF POTENTIAL CONCERN (COPCs)[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	Surface Soil (0 to 2 feet) (mg/kg)	All Soil (0 to 10 feet) (mg/kg)	Groundwater (mg/L)		Surface Water (mg/L)			Sediment (mg/kg)	
			Surficial Aquifer	Yorktown Aquifer	Slocum Creek	Turkey Gut	Leachate Seeps	Slocum Creek	Turkey Gut
Endosulfan I	--	--	0.000009[3]	--	--	--	--	--	--
Endrin Aldehyde	--	--	0.000079	--	--	--	--	--	--
Heptachlor	--	--	0.0000055[3]	--	--	--	0.0000775[3]	--	--
Heptachlor epoxide	--	--	0.00002[3]	--	--	0.0000019[3]	--	--	--
Aroclor-1260	0.0778	--	--	--	--	--	--	--	--
Aluminum	6,470	--	0.275	--	--	--	--	8,760[3]	11,100[3]
Antimony	3.6	--	--	--	--	--	0.0094[3]	10.6[3]	20.0[3]
Arsenic	17.1[3]	2.96	0.0967	--	--	0.00295[3]	0.0039[3]	32.7[3]	7.2[3]
Barium	--	--	0.0975	--	--	--	--	--	--
Beryllium	0.15	--	--	--	--	--	--	--	0.2[3]
Cadmium	2.2	1.35	0.00269	--	--	--	0.0242[3]	--	--
Chromium	24.1	--	--	--	--	--	--	57.5[3]	--
Copper	--	--	--	--	--	--	--	--	--
Iron	14,300	--	100.5[3]	1.8	--	--	40.4[3]	32,600[3]	18,200[3]
Lead	--	35.7	--	--	--	--	0.0241[3]	--	--
Manganese	78.6	--	0.760	0.063	--	--	0.494[3]	394[3]	182[3]
Mercury	--	--	--	--	--	--	--	--	--
Nickel	--	--	----	--	--	--	0.0979[3]	--	--
Silver	--	--	--	--	--	--	--	--	--
Thallium	0.99	--	--	--	--	--	0.00195[3]	--	--

1 95 Percent upper confidence limit, unless otherwise noted 2 -- - Not a COPC for this medium 3 Maximum concentration

TABLE 8-3

EXPOSURE ASSUMPTIONS - CURRENT LAND USE RECEPTORS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Pathway Parameters	Maintenance Worker	Adolescent Trespasser	Adult Recreational User	Units
Dermal Contact with Soil/Sediment				
Skin Surface Area	3,160	4,570/4,140[1]	5,170	cm^2
Adherence Factor	1.0	1.0	1.0	mg/cm^2
Absorption Factor	CSV[2]	CSV	CSV	unitless
Exposure Frequency	12	12	45	days/year
Exposure Duration	25	10	30	years
Body Weight	70	45	70	kg
Averaging Time - Noncancer	9,125	3,650	10,950	days
Averaging Time - Cancer	25,550	25,550	25,550	days
Incidental Ingestion of Soil Sediment				
Ingestion Rate	200	100	100	mg/day
Exposure Frequency	12	12	45	days/year
Exposure Duration	25	10	30	years
Body Weight	70	45	70	years
Averaging Time - Noncancer	9,125	3,650	10,950	days
Averaging Time - Cancer	25,550	25,550	25,550	days
Dermal Contact with Surface Water/Leachate				
Skin Surface Area	NA[4]	4,570/1,540[3]	19,400	cm^2
Permeability Constant	NA	CSV	CSV	cm/hour
Exposure Time	NA	1	1	hours/day
Exposure Frequency	NA	12	45	days/year
Exposure Duration	NA	10	30	years
Body Weight	NA	45	70	kg
Averaging Time - Noncancer	NA	3,650	10,950	days
Averaging Time - Cancer	NA	25,550	25,550	days

TABLE 8-3 (Continued)
EXPOSURE ASSUMPTIONS - CURRENT LAND USE RECEPTORS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Pathway Parameters	Maintenance Worker	Adolescent Trespasser	Adult Recreational User	Units
Incidental Ingestion of Surface Water/Leachate				
Ingestion Rate	NA	0.05/0.005[3]	0.05	liters/day
Exposure Time	NA	1	1	hours/day
Exposure Frequency	NA	12	45	days/year
Exposure Duration	NA	10	30	years
Averaging Time - Noncancer	NA	3,650	10,950	days
Averaging Time - Cancer	NA	25,550	25,550	days
Ingestion of Fish				
Bioconcentration Factor	NA	NA	CSV	liters/kg
Fraction Ingested from Contaminated Source	NA	NA	0.1	unitless
Ingestion Rate	NA	NA	0.284	kg/meal
Exposure Frequency	NA	NA	48	meals/year
Exposure Duration	NA	NA	30	years
Body Weight	NA	NA	70	kg
Averaging Time - Noncancer	NA	NA	10,950	days
Averaging Time - Cancer	NA	NA	25,550	days

(1) soil/sediment
(2) CSV - chemical specific value
(3) surface water/leachate
(4) NA - Not applicable

TABLE 8-4

EXPOSURE ASSUMPTIONS - FUTURE LAND USE RECEPTORS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Pathway Parameters	Adult Resident	Child Resident	Full-Time Employee	Construction Worker	Units
Inhalation of Fugitive Dust					
Inhalation Rate	NA[1]	NA	NA	4.8	m^3/hour
Absorption Factor	NA	NA	NA	0.125 - lungs 0.625 - gut	unitless
Exposure Time	NA	NA	NA	8	hours/day
Exposure Frequency	NA	NA	NA	180	days/year
Exposure Duration	NA	NA	NA	1	year
Body Weight	NA	NA	NA	70	kg
Averaging Time - Noncancer	NA	NA	NA	365	days
Averaging Time - Cancer	NA	NA	NA	25,550	days
Dermal Contact with Soil					
Skin Surface Area	5,230	3,910	3,160	4,300	cm^2
Adherence Factor	1.0	1.0	1.0	1.0	mg/cm^2
Absorption Factor	0.01/0.001[2]	0.01/0.001[2]	0.01/0.001[2]	0.01/0.001[2]	unitless
Exposure Frequency	350	350	250	180	days/year
Exposure Duration	6/24[3]	6	25	1	years
Body Weight	70	15	70	70	kg
Averaging Time - Noncancer	2,190/8,760	2,190	9,125	365	days
Averaging Time - Cancer	25,550	25,550	25,550	25,550	days
Incidental Ingestion of Soil					
Ingestion Rate	200	200	50	480	mg/day
Exposure Frequency	350	350	250	180	days/year
Exposure Duration	6/24	6	25	1	years
Body Weight	70	15	70	70	kg
Averaging Time - Noncancer	2,190/8,760	2,190	9,125	365	days
Averaging Time - Cancer	25,550	25,550	25,550	25,550	days

TABLE 8-4 (Continued)
EXPOSURE ASSUMPTIONS - FUTURE LAND USE RECEPTORS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Pathway Parameters	Adult Resident	Child Resident	Full-Time Employee	Construction Worker	Units
Dermal Contact with Groundwater					
Skin Surface Area	19,400	7,280	NA	4,300	cm^2
Permeability Constant	CSV[4]	CSV	NA	CSV	cm/hour
Exposure Time	12	12	NA	240	minutes/day
Exposure Frequency	350	350	NA	180	days/year
Exposure Duration	6/24	6	NA	1	years
Body Weight	70	15	NA	70	kg
Averaging Time - Noncancer	2,190/8,760	2,190	NA	365	days
Averaging Time - Cancer	25,550	25,550	NA	25,550	days
Ingestion of Groundwater					
Ingestion Rate	2	1	NA	NA	liters/day
Exposure Frequency	350	350	NA	NA	days/year
Exposure Duration	6/24	6	NA	NA	years
Body Weight	70	15	NA	NA	kg
Averaging Time - Noncancer	2,190/8,760	2,190	NA	NA	days
Averaging Time - Cancer	25,550	25,550	NA	NA	days
Inhalation of Volatiles in Groundwater					
Inhalation Rate	10	10	NA	NA	liters/minute
Shower Duration	12	12	NA	NA	minutes
Total Time in Bathroom	20	20	NA	NA	minutes
Air Exchange Rate	0.0083	0.0083	NA	NA	per minute
Exposure Frequency	350	350	NA	NA	showers/year
Exposure Duration	6/24	6	NA	NA	years
Body Weight	70	15	NA	NA	kg
Averaging Time - Noncancer	2,190/8,760	2,190	NA	NA	days
Averaging Time - Cancer	25,550	25,550	NA	NA	days

(1) NA - not applicable
(2) organics/inorganics
(3) adult evaluated for exposure durations of 6 and 24 years
(4) CSV - chemical-specific value

results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

Based on data collected from human studies, USEPA has developed weight of evidence classifications. Group A includes human carcinogens. Group B includes probable human carcinogens. B1 indicates that limited data are available. B2 indicates sufficient evidence in animals and inadequate or no evidence in humans. Group C includes possible human carcinogens. Chemical in Group D are not classifiable as to human carcinogenicity. Group E indicates evidence of noncarcinogenicity for humans.

The increased cancer risk is expressed by terms such as 1E-6. To state that a chemical exposure causes a 1E-6 added upper limit risk of cancer means that if one million people are exposed, one additional incident of cancer is expected to occur. The calculations and assumptions yield an upper limit estimate that assures that no more than one case is expected and, in fact, there may be no additional cases of cancer. USEPA policy has established that an upper limit cancer risk falling below or within the range of 1E-6 to 1E-4 is acceptable.

RfDs have been developed by USEPA for indicating the potential for adverse health effects from exposure to a COPC exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure for humans, including sensitive individuals. Estimated intakes of COPCs from environmental media (e.g., the amount of a COPC ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). If the estimated exposure to a chemical, expressed as mg/kg-day, is less than the RfD, exposure is not expected to cause any noncarcinogenic effects, even if exposure is continued for a lifetime. In other words, if the estimated dose divided by the RfD is less than 1.0, there is no concern for adverse noncarcinogenic effects.

Dose-response parameters (CSFs, RfDs, absorption factors, and weight of evidence) used in the risk assessment are summarized in Table 8-5.

8.1.4 Risk Characterization

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

TABLE 8-5

DOSE-RESPONSE PARAMETERS FOR CHEMICALS OF POTENTIAL CONCERN[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	Chronic/Subchronic RfD (mg/kg/day)[2]			CSF(kg-day/mg)[3]			GI[4] Absorption Factor	Weight of Evidence
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal		
Volatile Organics								
1,1-Dichloroethene		7E-3 (UF = 1000; liver)	9E-3	1.75E-1 (kidney)	6E-1 (adrenal tumors)	7.5E-1	0.80[5]	C
1,2-Dichloroethane		2.86E-3[9] (UF = 3000; CNS, GI tract, liver, kidney)	2.3E-3	9.1E-2	9.1E-2 (hemangiosarcoma)	1.1E-1	0.80[5]	B2
1,2-Dichloropropane	1.14E-3 (UF = 300; nasal hyperplasia)				6.8E-2[16] (liver)	8.5E-2	0.80[5]	B2
2-Butanone	2.86E-1 (UF = 1000; birth wt)	6E-1 (UF = 3000; birth wt)	4.8E-1				0.80[5]	
2-Hexanone	2.29E-2[27]	8E-2[27]	6.4E-2				0.80[5]	
4-Methyl-2-pentanone	2.29E-1, 2.29E-2[18] (UF = 100/1000; liver, kidney)	8E-1, 8E-2[18] (UF = 300/3000; liver, kidney)	6.4E-2				0.80[5]	
Benzene	1.71E-3[8] (UF = 1000; hematopoietic system	3E-4[24]	3E-4	2.9E-2 (leukemia, neoplasia)	2.9E-2 (leukemia, neoplasia)	2.9E-2	1.0[8]	A
Chlorobenzene	5.71E-3[18] (UF = 10,000; liver, kidney)	2E-2 (UF = 1000; liver)	6.2E-3				0.31[10]	D
Chloroethane	2.86E+0 (UF = 300; fetus)	4E-1[8]	3.2E-1				0.80[5]	
Chloroform		1E-2 (UF = 1000; liver)	1E-2	8.05E-2 (liver)	6.1E-3 (kidney)	6.1E-3	1.0[11]	B2
cis-1,2-Dichloroethene		1E-2[18] (UF = 3000; blood)	8E-3				0.80[5]	D

TABLE 8-5 (Continued)
DOSE-RESPONSE PARAMETERS FOR CHEMICALS OF POTENTIAL CONCERN[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	Chronic/Subchronic RfD (mg/kg/day)[2]			CSF(kg-day/mg)[3]			GI[4] Absorption Factor	Weight of Evidence
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal		
Ethylbenzene	2.86E-1 (UF=300; development)	1E-1 (UF=1000; liver, kidney)	8E-2				0.80[5]	
Methylene chloride	8.57E-1[16] (UF=100; liver)	6E-2 (UF=100; liver)	6E-2	1.64E-3 (liver; respiratory)	7.5E-3 (liver; respiratory)	7.5E-3	1.0[12]	B2
Tetrachloroethene		1E-2 (UF=1000; liver)	1E-2	2.03E-3[28] (liver)	5.2E-2[9] (liver)	5.2E-2	1.0[13]	B2/C
Toluene	1.14E-1 (UF=300; CNS; nasal mucosa)	2E-1 (UF=1000; liver, kidney)	1.6E-1				0.80[5]	D
Trichloroethene		6E-3[28]	6E-3	6.0E-3[28] (liver)	1.1E-2[26] (liver)	1.1E-2	1.0[14]	
Vinyl chloride				3.0E-1[15] (liver)	1.9E+0[15] (lung, liver)	2.38E+0	0.80[5]	A
Semivolatile Organics								
1,2-Dichlorobenzene	4E-2[16] (UF=1000; whole body)	9E-2 (UF=1000)	9E-2				1.0[28]	D
1,4-Dichlorobenzene	2.29E-1 (UF=100; liver)				2.4E-2[16] (liver)	2.4E-2	1.0[7]	B2
2,4-Dimethylphenol		2E-2 (UF=3000; lethargy, blood)	1E-2				0.50[5]	
2-Methylnaphthalene		4E-2[27]	2E-2				0.50[5]	
2-Methylphenol		5E-2 (UF=1000; body wt, neurotoxicity	2.5E-2				0.50[5]	
4-Methylphenol		5E-3[15] (UF=1000; CNS, respiratory)	2.5E-3				0.50[5]	C

TABLE 8-5 (Continued)
DOSE-RESPONSE PARAMETERS FOR CHEMICALS OF POTENTIAL CONCERN[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	Chronic/Subchronic RfD (mg/kg/day)[2]			CSF(kg-day/mg)[3]			GI[4] Absorption Factor	Weight of Evidence
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal		
Benzo(a)anthracene				3.1E-1[29]	7.3E-1[29] (liver)	3.65E-1	0.50[5]	B2
Benzo(a)pyrene				3.1E+0[25] (respiratory tract)	7.3E+0 (forestomach, liver, esophagus)	3.65E+0	0.50[5]	B2
Benzo(b)fluoranthene				3.1E-1[29]	7.3E-1[29] (liver)	3.65E-1	0.50[5]	B2
Benzo(k)fluoranthene				3.1E-2[29]	7.3E-1[29] (liver)	3.65E-2	0.50[5]	B2
Bis(2-chloroethyl)ether				1.16E+0 (hepatoma)	1.1E+0 (hepatoma)	2.2E+0	0.50[5]	B2
Bis(2-ethylhexyl)phthalate		2E-2 (UF = 1000; liver)	1.1E-2		1.4E-2 (liver)	2.55E-2	0.55[15]	B2
Chrysene				3.1E-3[29]	7.3E-3[29]	3.65E-3	0.50[5]	B2
Indeno(1,2,3-cd)pyrene				3.1E-1[29]	7.3E-1[29]	3.65E-1	0.50[5]	B2
Naphthalene		4E-2[26]	2E-2				0.50[5]	D
Nitrobenzene	5.71E-4[18] (UF-10,000; blood, liver, kidney)	5E-4 (UF = 10000; blood, liver, kidney)	2.5E-4				0.50[5]	D
Pesticides/PCBs								
4,4'-DDD					2.4E-1 (liver)	2.5E-1	0.80[30]	B2
4,4'-DDE					3.4E-1 (liver)	4.2E-1	0.80[30]	B2
4,4'-DDT		5E-4 (UF = 100; liver)	4E-4	3.4E-1 (liver)	3.4E-1 (liver)	4.2E-1	0.80[30]	B2
Aldrin		3E-5 (UF = 1000; liver)	1.5E-5	1.71E+1 (liver)	1.7E+1 (liver)	3.4E+1	0.50[6]	B2
α-BHC				6.3E+0 (liver, kidney)	6.3E+0 (liver, kidney)	1.3E+1	0.50[5]	

TABLE 8-5 (Continued)
DOSE-RESPONSE PARAMETERS FOR CHEMICALS OF POTENTIAL CONCERN[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	Chronic/Subchronic RfD (mg/kg/day)[2]			CSF(kg-day/mg)[3]			GI[4] Absorption Factor	Weight of Evidence
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal		
γ-BHC		3E-4 (UF = 1000; liver, kidney)	1.5E-4		1.3E+0[16] (liver)	2.6E+0	0.50[5]	B2/C
Dieldrin		5E-5 (UF = 100; liver)	2.5E-5	1.61E+1 (liver)	1.6E+1 (liver)	3.2E+1	0.50[5]	B2
Endosulfan I		6E-3[27] (UF = 100; body wt)	3E-3				0.50[5]	
Endosulfan II		6E-3[27] (UF = 100; body wt)	3E-3				0.50[5]	
Endrin aldehyde		3E-4[27]	1.5E-4				0.50[5]	
Heptachlor		5E-4 (UF = 300; liver)	2.5E-4	4.55E+0 (liver)	4.5E+0 (liver)	9.0E+0	0.50[5]	B2
Heptachlor epoxide		1.3E-5 (UF = 1000; liver)	6.5E-6	9.1E+0 (liver)	9.1E+0 (liver)	1.82E+1	0.50[5]	B2
Aroclor-1260					7.7E+0 (liver)	1.5E+1	0.50[5]	B2
Inorganics								
Aluminum		1E+0[9]	2E-1				0.20[5]	
Antimony		4E-4 (UF = 1000; whole body, blood)	8E-5				0.20[5]	
Arsenic		3E-4 (UF = 3; skin)	2.85E-4	1.51E+1 (lung)	1.5E+0 (skin)	1.6E+0	0.95[17]	A
Barium	1.43E-4[18] (UF = 1000; fetus)	7E-2 (UF = 3; cardiovascular system)	1.4E-2				0.20[5]	
Beryllium		5E-3 (UF = 100)	5E-5	8.4E+0 (lung; osteosarcomas)	4.3E+0 (lung; osteosarcomas)	4.3E+2	0.01[18]	B2

TABLE 8-5 (Continued)
DOSE-RESPONSE PARAMETERS FOR CHEMICALS OF POTENTIAL CONCERN[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical	Chronic/Subchronic RfD (mg/kg/day)[2]			CSF(kg-day/mg)[3]			GI[4] Absorption Factor	Weight of Evidence
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal		
Cadmium		5E-4 (UF = 10; kidney)	1.5E-5	6.3E+0 (lung; trachea)			0.03[19]	B1
Chromium VI		5E-3 (UF = 500)	5E-5	4.2E+1 (lung)			0.01[20]	A
Copper		4E-2[9] (gastrointestinal system)	2.4E-2				0.60[21]	
Iron		3E-1[10] (none)	6E-2				0.20[5]	
Lead								B2
Manganese	1.43E-5 (UF = 1000; CNS)	2.4E-2 (UF = 3; CNS)	4.6E-3				0.20[5]	D
Mercury	8.57E-5[11] (UF = 30; CNS)	3E-4[11] (UF = 1000; kidney)	6E-5				0.20[5]	D
Nickel		2E-2 (UF = 300; body weight)	8E-4				0.40[23]	
Silver		5E-3 (UF = 3; argyria)	1E-3				0.20[5]	
Thallium		7E-5[22,28] (UF = 3000; liver, blood, hair)	1.4E-5				0.20[5]	D

1 All values from USEPA, May 1996 (IRIS) unless otherwise noted
2 RfD - Reference Dose
3 CSF - Cancer Slope Factor
4 GI - Gastrointestinal
5 USEPA Region IV default value (November 1995)
6 Assumed equal to 1,4-dichlorobenzene
7 ATSDR, October 1991a
8 ATSDR, October 1991b
9 ECAO provisional value
10 ATSDR, October 1989a
11 ATSDR, October 1991c
12 ATSDR, October 1991d
13 ATSDR, October 1991e
14 ATSDR, January 1988
15 ATSDR, October 1991f
16 HEAST FY-1995 (USEPA, May 1995)
17 ATSDR, October 1991g
18 ATSDR, October 1991h
19 ATSDR, October 1991i
20 ATSDR, October 1991j
21 ATSDR, October 1989b
22 Thallic oxide; HEAST FY-1990 (USEPA, January 1990)

TABLE 8-5 (Continued)
DOSE-RESPONSE PARAMETERS FOR CHEMICALS OF POTENTIAL CONCERN[1]
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

24 USEPA Region IV provisional value identified in comments received on RI report. Uncertainty factor and target organs not available.
25 Provisional value listed in USEPA Region IV, November 1995.
26 Withdrawn from IRIS.
27 Surrogate value provided.
28 Other USEPA document referenced in USEPA Region III, May 1996.
29 Based on USEPA Region IV Toxicity Equivalence Factors (TEFs; USEPA Region IV, November 1995).
30 ATSDR 1992.

$$\text{Risk} = \text{CDI} \times \text{CSF}$$

Where:

Risk = a unitless probability (e.g., 2E-6) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
CSF = cancer slope factor, expressed as $(\text{mg/kg-day})^{-1}$

These risks are probabilities that are generally expressed in scientific notation (e.g., 1E-6). An excess lifetime cancer risk of 1E-6 indicates that, as a reasonable maximum estimate, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at OU2.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with a reference dose derived for a similar exposure period. The ratio of exposure to toxicity is called a Hazard Quotient (HQ). By adding the HQs for all COPCs that affect the same target organ (e.g, liver) within a medium or across all media to which a given population may be reasonably exposed, the Hazard Index (HI) can be generated.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI}/\text{RfD}$$

Where:

CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

To evaluate cancer risks, a risk level lower than 1E-6 is considered a minimal or *de minimis* risk. The risk range of 1E-6 to 1E-4 is an acceptable risk range and would not be expected to require a response action. A risk level greater than 1E-4 would be evaluated further, and remedial action to decrease the estimated risk is considered.

An HI of less than unity (1.0) indicates the exposures are not expected to cause adverse health effects. An HI greater than 1.0 requires further evaluation. For example, although HQs of the several chemicals present are added and exceed 1.0, further evaluation may show that their toxicities are not additive because each chemical affects different target organs. When total effects are evaluated on an effect and target organ basis, the HI of the separate chemicals may be at acceptable concentrations.

Carcinogenic risks and noncarcinogenic hazards were evaluated for potential exposures to media-specific COPCs in surface soil, subsurface soil, surface water, sediment, leachate seeps, and groundwater (both surficial aquifer and Yorktown aquifer). Receptor populations that may potentially be exposed are maintenance workers, construction workers, adolescent trespassers, adult recreational users, full-time employees, and adult and child residents who could, theoretically, use groundwater for a household water source. Risks and hazards estimated for the identified receptors at OU2 are provided in Table 8-6.

The risks shown in Table 8-6 indicate that even under the conservative assumptions made during the risk assessment (e.g., frequent use of the maximum detected contaminant concentration as the exposure concentration), risks are within the target risk range except for the adult resident (Hazard Index and cancer risk) and child resident (Hazard Index and cancer risk).

The majority of the cancer risk to future residents is from ingestion of shallow groundwater (surficial aquifer) containing arsenic and vinyl chloride. For noncarcinogenic risks, individual exposure routes with HIs greater than 1 were ingestion of soil containing arsenic by a child resident and ingestion of groundwater containing arsenic and iron by adults and children. The exposure scenario for soil was based on the maximum detected concentration of arsenic; therefore, the HI is an extremely conservative value.

For the sake of completeness, a 30-year residential exposure scenario was also evaluated. This scenario is highly unlikely to occur as long as the property remains in military use (i.e., a 30-year residence is extremely conservative). Incremental cancer risks associated with exposure to soil for this receptor assume 6 years of exposure as a small child and an additional 24 years of exposure as an older child and adult. The incremental cancer risk for the adult receptor under this exposure scenario is 2.5E-3 (which exceeds the USEPA target risk range). Arsenic and vinyl chloride are the major risk drivers for groundwater, and arsenic drives the soil risks.

In addition to the future potential exposure to the surficial aquifer, potential potable use of the Yorktown aquifer and exposure to surface soil was also considered. Both aquifers would not be used as a source of potable water at the same time. The only noncarcinogenic risk is from ingestion of soil containing arsenic by a child resident.

TABLE 8-6

SUMMARY OF CUMULATIVE RISKS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Receptor	Exposure Pathway	Cancer Risk	Hazard Index
Maintenance Worker	Direct contact with surface soil.	1.0E-6	0.016
Construction Worker	Direct contact with soil and groundwater; inhalation of fugitive dust.	7.6E-7	0.61
Adolescent Trespasser	Direct contact with surface soil and leachate seeps.	3.9E-7	0.020
	Direct contact with Slocum Creek water and sediment.	2.8E-7	0.016
	Direct contact with Turkey Gut water and sediment.	1.3E-7	0.0081
Adult Recreational User	Direct contact with Slocum creek water and sediment; ingestion of fish.	4.0E-5	0.044
Full-Time Employee	Direct contact with surface soil.	6.4E-6	0.10
Adult Resident (6 year)	Direct contact with groundwater (surficial aquifer) and surface soil.	3.8E-4*[1]	22*
	Direct contact with groundwater (Yorktown aquifer) and surface soil.	4.9E-6	0.55
Child/Adult Resident (30 year)[2]	Direct contact with groundwater (surficial aquifer) and surface soil.	2.5E-3*	51*/22*
	Direct contact with groundwater (Yorktown aquifer) and surface soil.	5.6E-5	2.8*/0.55
Child Resident	Direct contact with groundwater (surficial aquifer) and surface soil.	9.2E-4*	51*
	Direct contact with groundwater (Yorktown aquifer) and surface soil.	3.6E-5	2.8*

(1) An asterisk indicates an "unacceptable" risk.
(2) Includes 6 years as child and 24 years as adult. The 30-yr child/adult cancer risk was obtained by adding the 6-yr. child cancer risk and the 24-yr. adult cancer risk. HIs are not additive. This first HI value is for a 6-yr. child, and the second value is for a 24-yr. adult.

8.1.5 Risk Uncertainty

The intent of this section is to identify important uncertainties and limitations associated with the baseline human health risk assessment. Exposure scenarios based on USEPA guidance use conservative assumptions, which means actual risk will not be greater than that estimated and may be lower. For this reason, estimated cancer risks based on USEPA guidance, such as those presented in this document, may not represent actual risks to the population.

Because of data set limitations, the 95th percentile may exceed the maximum concentration reported in some evaluations. This may occur when there are a large number of nondetects and the detection limits are unusually high due because of interferences in the analyses. In these cases, consistent with USEPA Region IV guidance, the maximum reported values were used as exposure point concentrations to estimate human exposures. Although the use of maximum values is generally recognized as an appropriate screening approach, it should be recognized that this procedure may overestimate actual exposure.

This is also the case for use of detection limits as nondetect values when a chemical has been reported as not detected in most of the samples collected and analyzed. Since some nondetects may be zero, assuming that a concentration equal to half the detection limit is present instead of zero may overestimate actual chemical concentrations on site. This is particularly true if interfering chemicals affect the analyses, and the nondetect value is elevated.

Environmental sampling and analysis can contain significant errors and artifacts. At OU2, data used in the risk assessment are believed to adequately and accurately represent current conditions.

When long-term health effects are evaluated, it is assumed that chemical concentrations are constant for the exposure period being evaluated. This may not be accurate since reported chemical concentrations are changing because of various degradation processes (e.g., dilution by uncontaminated water, sorption, dispersion of contaminated groundwater, volatilization, biodegradation, chemical degradation, photodegradation). Use of steady-state conditions will likely overestimate exposure.

Exposures to vapors at the site, fugitive dust (except for future construction workers), dermal contact with groundwater from household uses other than bathing (e.g., laundry, washing dishes), and other possible exposures to site media were not evaluated. Although these and other exposures could occur, the magnitudes of these exposures are expected to be much lower than the exposures evaluated and would not quantitatively affect the total health impact from the site.

Since groundwater from the surficial and Yorktown aquifers in the surrounding area is not used for drinking water or other household water needs, exposures related to drinking and bathing are theoretical and relate to potential future exposures. This is unlikely because the Air Station has a separate potable water distribution system.

In hazard and risk evaluations, risks or hazards presented by several chemicals reported for the same exposure have been added to provide a sum of estimated total risk or hazard for that particular exposure. This is a conservative assumption and is scientifically accurate only in those instances where health effects of individual chemicals are directed at the same effect and same target organ. Effects may be additive, synergistic, or antagonistic. Since a large number of chemicals have no similarity as to their noncarcinogenic action or target of their action, this approach may overestimate risk.

Risks calculated from slope factors are derived using a linearized multistage procedure; therefore, they are likely to be conservative upper-bound estimates. Actual risks may be much lower.

Toxicity information is not available for all COPCs. Because RfDs, CSFs, and other toxicity criteria are not available for all identified chemicals, it is impossible to qualitatively or quantitatively assess the risks associated with exposure to some substances. Some compounds were not selected as COPCs based on screening values for similar compounds. There is not toxicity information for lead.

Some uncertainty is associated with the evaluation of carcinogenic effects from oral exposure to arsenic, and there is no published oral CSF. The uncertainties associated with the ingestion of arsenic are high, such that estimated risks may be overestimated by as much as an order of magnitude.

8.1.6 Human Health Risk Summary

Risk and hazards associated with exposure to all environmental media (and combinations) were within the USEPA generally acceptable ranges for the current maintenance worker, adolescent trespasser, and adult recreational user and the future construction worker and full-time employee.

For the unlikely hypothetical future site resident, exposure media were shown to exceed acceptable residential goals. These media include surface soil and surficial aquifer groundwater.

For future residents, several chemicals have individual cancer risks greater than 1E-6 and/or an HI greater than 0.1, making them chemicals of concern for groundwater. These analytes are as follows: benzene,

chlorobenzene, 1,1-dichlorothene, vinyl chloride, bis(2-chloroethyl)ether, 1,4-dichlorobenzene, 4-methylphenol, nitrobenzene, heptachlor epoxide, arsenic, cadmium, iron, and manganese.

Exposure to surface soil at OU2 results in unacceptable risks (HIs) only for future child residents. There are however, several chemicals that contributed individual ICRs greater than 1E-6 or HIs greater than 0.1 for residential or full-time employee exposures, making them chemicals of concern for soil. These chemicals are as follows: benzo(a)pyrene, antimony, arsenic, beryllium, chromium, iron, and thallium.

USEPA Region IV requires, as part of the risk assessment, an estimation of Remedial Goal Options (RGOs) for three risk range levels for any receptor for which an individual chemical has an ICR greater than 1E-6 or an HI greater than 0.1.

Tables 8-7 and 8-8 present RGOs for groundwater for the 6-year resident and 30-year resident exposures, respectively. These tables also contain MCLs and state groundwater standards.

Tables 8-9, 8-10, and 8-11 present RGOs for surface soil for the 6-year resident, 30-year resident, and full-time employee exposures.

In addition to the COCs based on risk (i.e., protection of human health), many groundwater analytes exceed state standards and/or MCLs and several soil analytes exceed concentrations based on protection of groundwater, also making them COCs. Table 8-12 presents the chemicals that exceed state groundwater standards and/or MCLs. Table 8-13 presents soil contaminants that exceed RGOs based on protection of groundwater.

Actual or threatened releases of hazardous substances from OU2, if not addressed by implementing the remedy selected in this ROD, may present a potential threat to public health, welfare, or the environment.

8.2 ECOLOGICAL RISK ASSESSMENT

There are no critical habitats or endangered species or habitats that are affected by site contamination. Several wetland areas were identified at OU2 during a field survey conducted in April 1995. The wetlands are adjacent to Slocum Creek and Turkey Gut and are classified as Coastal Plain Small Stream Swamp areas.

The maximum surface water and sediment exposure point concentrations and estimated dose received by receptors were compared to benchmark values that are protective of ecological receptors. The maximum

TABLE 8-7

REMEDIAL GOAL OPTIONS FOR GROUNDWATER - FUTURE RESIDENT (6-YEAR)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	RGOs for Target Cancer Risk (μg/L)			RGOs for Target Hazard Quotient (μg/L)			NC Class GA Standards (μg/L)	Federal MCL (μg/L)
	1E-6	1E-5	1E-4	0.1	1	10		
Benzene	3.8	38	380	4.4	44	440	1.0	5.0
Chlorobenzene	NA[2]	NA	NA	26	260	2,600	50	100
1,1-Dichloroethene	0.25	2.5	25	-[1]	-	-	7.0	7.0
Vinyl chloride	0.086	0.86	8.6	NA	NA	NA	0.015	2.0
Bis(2-chloroethyl)ether	0.16	1.6	16	NA	NA	NA	DL[5]	NS[3]
1,4-Dichlorobenzene	6.9	69	690	3,400	34,000	340,000	75	75
4-Methylphenol	NA	NA	NA	7.6	76	760	DL	NS
Nitrobenzene	NA	NA	NA	0.77	7.7	77	DL	NS
Heptachlor epoxide	0.019	0.19	1.9	-	-	-	0.004	0.2
Arsenic	0.1	1.0	10	0.47	4.7	47	50	50
Cadmium	NA	NA	NA	0.74	7.4	74	5.0	5.0
Iron	NA	NA	NA	460	4,600	46,000	300	300[4]
Manganese	NA	NA	NA	7.8	78	780	50	50[4]

1 Concentration of contaminant at site results in a Hazard Index less than 0.1.
2 NA - Not applicable. No cancer slope factor or Reference Dose for this chemical.
3 NS - No standard.
4 Secondary MCL.
5 DL - Detection Limit. Any detection is considered an exceedance of state standard.

TABLE 8-8

REMEDIAL GOAL OPTIONS FOR GROUNDWATER - FUTURE RESIDENT (30-YEAR)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	RGOs for Target Cancer Risk (μg/L)			RGOs for Target Hazard Quotient (μg/L)			NC Class GA Standards (μg/L)	Federal MCL (μg/L)
	1E-6	1E-5	1E-4	0.1	1	10		
Benzene	1.6	16	160	3.6	36	360	1.0	5.0
Chlorobenzene	NA[2]	NA	NA	18	180	1,800	50	100
1,1-Dichloroethene	0.097	0.97	9.7	-[1]	-	-	7.0	7.0
Vinyl chloride	0.032	0.32	3.2	NA	NA	NA	0.015	2.0
Bis(2-chloroethyl)ether	0.059	0.59	5.9	NA	NA	NA	DL[5]	NS[3]
1,4-Dichlorobenzene	2.5	25	250	610	6,100	61,000	75	75
4-Methylphenol	NA	NA	NA	5.3	53	530	DL	NS
Nitrobenzene	NA	NA	NA	0.54	5.4	54	DL	NS
Heptachlor epoxide	0.0069	0.069	0.69	0.014	0.14	1.4	0.004	0.2
Arsenic	0.038	0.38	3.8	0.33	3.3	33	50	50
Cadmium	NA	NA	NA	0.52	5.2	52	5.0	5.0
Iron	NA	NA	NA	330	3,300	33,000	300	300[4]
Manganese	NA	NA	NA	5.4	54	540	50	50[4]

1 Concentration of contaminant at site results in a Hazard Index less than 0.1.
2 NA - Not applicable. No cancer slope factor or Reference Dose for this chemical.
3 NS - No standard.
4 Secondary MCL.
5 DL - Detection Limit. Any detection is considered an exceedance of state standard.

TABLE 8-9

REMEDIAL GOAL OPTIONS FOR SOIL - FUTURE RESIDENT (6-YEAR)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	RGOs for Target Cancer Risk (mg/kg)			RGOs for Target Hazard Quotient (kg/kg)		
	1E-6	1E-5	1E-4	0.1	1	10
Benzo(a)pyrene	0.12	1.2	12	NA[1]	NA	NA
Antimony	NA	NA	NA	2.9	29	290
Arsenic	0.51	5.1	51	2.3	23	230
Beryllium	0.072	0.72	7.2	13.3	133	1,330
Chromium (IV)	NA	NA	NA	13.3	133	1,330
Iron	NA	NA	NA	2,140	21,400	214,000
Thallium	NA	NA	NA	0.5	5.0	50

1 NA - Not applicable. No cancer slope factor or Reference Dose for this chemical.

TABLE 8-10

REMEDIAL GOAL OPTIONS FOR SOIL - FUTURE RESIDENT (30-YEAR)
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	RGOs for Target Cancer Risk (mg/kg)			RGOs for Target Hazard Quotient (mg/kg)		
	1E-6	1E-5	1E-4	0.1	1	10
Benzo(a)pyrene	0.088	0.88	8/8	NA[1]	NA	NA
Antimony	NA	NA	NA	2.5	25	250
Arsenic	0.35	3.5	35	2.1	21	210
Beryllium	0.038	0.38	3.8	11	110	1,100
Chromium (VI)	NA	NA	NA	12	120	1,200
Iron	NA	NA	NA	1,900	19,000	190,000
Thallium	NA	NA	NA	0.45	4.5	45

1 NA - Not applicable. No cancer slope factor or Reference Dose for this chemical.

TABLE 8-11

REMEDIAL GOAL OPTIONS FOR SOIL - FUTURE FULL-TIME EMPLOYEE
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Analyte	RGOs for Target Cancer Risk (mg/kg)			RGOs for Target Hazard Quotient (mg/kg)		
	1E-6	1E-5	1E-4	0.1	1	10
Benzo(a)pyrene	-[1]	-	-	NA[2]	NA	NA
Antimony	NA	NA	NA	-	-	-
Arsenic	1.2	12	120	-	-	-
Beryllium	0.18	1.8	18	140	1,400	14,000
Chromium (VI)	NA	NA	NA	140	1,400	14,000
Iron	NA	NA	NA	46,600	466,000	4,660,000
Thallium	NA	NA	NA	-	-	-

1 Concentration of contaminant at site results in a cancer risk less than 1E-6 or Hazard Index less than 0.1.

2 NA - Not applicable. No cancer slope factor or Reference Dose for this chemical.

TABLE 8-12

GROUNDWATER COCs THAT EXCEED MCLs OR STATE GROUNDWATER STANDARDS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical of Concern	NC Class GA Standard (µg/L)	Federal MCL (µg/L)
Benzene	1	5
Chlorobenzene	50	100
Chloroform	0.19	100
1,2-Dichloroethane	0.38	5
cis-1,2-Dichloroethene	70	70
1,2-Dichloropropane	0.56	5
Ethylbenzene	29	700
2-Hexanone	DL[1]	NS[2]
4-Methyl-2-pentanone	DL	NS
Tetrachloroethene	0.7	5
Trichloroethene	2.8	5
Vinyl chloride	0.015	2
Bis(2-chloroethyl)ether	DL	NS
Bis(2-ethylhexyl)phthalate	3	6
2,4-Dimethylphenol	DL	NS
2-Methylnaphthalene	DL	NS
2-Methylphenol	DL	NS
4-Methylphenol	DL	NS
Naphthalene	21	NS
Nitrobenzene	DL	NS
Aldrin	DL	NS
alpha-BHC	DL	NS
4,4'-DDE	DL	NS
4,4'-DDT	DL	NS
Endosulfan I	DL	NS
Endosulfan II	DL	NS

TABLE 8-12 (Continued)
GROUNDWATER COCs THAT EXCEED MCLs OR STATE GROUNDWATER STANDARDS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical of Concern	NC Class GA Standard (µg/L)	Federal MCL (µg/L)
Endrin aldehyde	DL	NS
Heptachlor epoxide	0.004	0.2
Arsenic	50	50
Cadmium	5	5
Iron	300	300(3)
Manganese	50	50(3)

(1) DL - Detection limit. Any detection is considered an exceedance of state standard.
(2) NS - No standard.
(3) Secondary MCL.

TABLE 8-13

REMEDIAL OPTIONS FOR SOIL - PROTECTION OF GROUNDWATER
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical of Concern	NC S-3 Target Concentration
Organics (µg/kg)	
Benzene	5.6
2-Butanone	687
Chlorobenzene	432
Chloroform	0.96
1,2-Dichloroethane	1.7
cis-1,2-Dichloroethene	350
trans-1,2-Dichloroethene	400
trans-1,3-Dichloropropene	1.2
Ethylbenzene	343
Methylene chloride	21.9
Tetrachloroethene	5.9
Toluene	8,111
1,1,1-Trichloroethane	1,484
Trichloroethene	20.7
Vinyl chloride	0.09
2,4-Dimethylphenol	1,194
2-Methylnaphthalene	3,235
4-Methylphenol	205
Naphthalene	925
Dieldrin	1.8
Heptachlor epoxide	6.7

TABLE 8-13 (Continued)
REMEDIAL OPTIONS FOR SOIL - PROTECTION OF GROUNDWATER
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Chemical of Concern	NC S-3 Target Concentration
Metals (mg/kg)	
Cadmium	2.7
Iron	151
Lead	270
Manganese	65.2
Nickel	56.4
Silver	0.22

and mean (i.e., average of positive detections) soil exposure point concentrations and estimate dose received by receptors were also compared to benchmark values that are protective of ecological receptors. Contaminants exceeding these values were regarded as ecological COPCs, and their toxicological properties were summarized. The relative potential risks that each of these COPCs might pose to ecological receptors inhabiting the area near OU2 were then evaluated in the form of Hazard Quotients.

Only a few COPCs were identified in Turkey Gut surface waters, and their HQs were relatively low. The organic COPCs were only detected at one location. The inorganic COPCs were also detected above benchmark values in the most upstream sample. Potential risks to aquatic receptors from surface water contamination alone are expected to be minimal. In Turkey Gut sediments, only a few COPCs were identified, and related HQs were relatively low. Most of the benchmark values were only exceeded at one location. The concentrations at these locations were below or close to ER-M levels. The pesticide COPCs identified may be a concern because of their tendency to persist and bioaccumulate. However, these pesticides are no longer in use and were not COPCs in OU2 site soil. In addition, pesticides were also detected in background soil samples collected at the Air Station (not only at OU2). Some of the detections do not appear to be solely related to activities at OU2.

Only two COPCs (4,4'-DDD and copper) were identified in Slocum Creek surface water. The COPCs were detected at similar concentrations in all samples collected from Slocum Creek, including the location upstream of OU2. Therefore, these detections do not appear to be solely related to activities at OU2, and OU2 may not be only contributor of these COPCs. Only a few COPCs were identified in Slocum Creek sediment, and the concentrations that exceeded benchmark values were only detected at one location. The exceedances of benchmarks are considered to be isolated occurrences and are not believed to be a significant concern. Slocum Creek has been designated as a separate operable unit that will be evaluated at a later date.

Based on maximum contaminant concentrations, the benchmark values for the soil COPCs were only exceeded at six sample locations, suggesting a lack of widespread contamination. In addition, some of the benchmark values were based on human health or agricultural scenarios. Based on average concentrations and ecologically-based benchmarks, Aroclor-1260 was the only COPC. This chemical was only detected in one surface soil sample. As a result, risks to terrestrial receptors from contamination in OU2 soils appear to be insignificant.

The results of the ecological assessment indicate that some contaminants are present in concentrations that result in HQs indicative of potential risk. However, risks impled by these exceedances are mitigated by several factors.

- Only a few COPCs were identified at OU2.

- HQs for surface water, sediment, and soil COPCs based on comparisons with benchmark toxicity values were relative low.

- Detections of any of the COPCs were isolated or may not be entirely site related. Exceedances of benchmark toxicity values in Slocum Creek and Turkey Gut were limited to single locations or exceedances occurred at locations upstream of OU2. Based on maximum concentrations, soil benchmark toxicity values were only exceeded at six widely spaced locations. Based on average concentrations, the benchmark values were only exceeded at one location.

- Most of the contaminants posing potential risk from exposure to Turkey Gut sediment were also detected in background soil samples collected at the Air Station (not only at OU2).

- Risk numbers generated from the food chain models were based on scattered detections of chemicals. The models conservatively assumed that the receptors would be exposed to the detections their entire life. In addition, the risk values were mainly driven by uncertainty in toxicity data, rather than actual risk.

9.0 DESCRIPTION OF ALTERNATIVES

The OU2 FS presents the results of the detailed analysis of four potential remedial action alternatives for groundwater and six potential remedial action alternatives for soil. These alternatives have been developed to provide a range of remedial actions for the site. This section of the ROD summarizes the alternatives that are described in the FS.

The following alternatives have been developed for groundwater at OU2.

- Groundwater Alternative 1 - No Action.
- Groundwater Alternative 2 - Natural Attenuation and Institutional Controls.
- Groundwater Alternative 3 - Groundwater Extraction; Treatment and Discharge to Slocum Creek or Pretreatment and Discharge to Sewage Treatment Plant (STP); Institutional Controls.
- Groundwater Alternative 4 - Air Sparging/Soil Vapor Extraction; Institutional Controls.

The following alternatives have been developed for soil and buried waste at OU2:

- Soil Alternative 1 - No Action
- Soil Alternative 2 - Institutional Controls
- Soil Alternative 3 - Soil Vapor Extraction; Institutional Controls
- Soil Alternative 4 - Excavation, Consolidation, and Containment; Institutional Controls
- Soil Alternative 5 - Excavation, Treatment, and Onsite Disposal; Institutional Controls
- Soil Alternative 6 - Excavation and Offsite Disposal; Institutional Controls

The remedial action alternatives for soil and groundwater were developed to address contaminated groundwater and soil and various areas of concerns (or soil hot spots) within OU2. The areas of concern were identified by comparing media-specific contaminant concentrations detected at OU2 to media-specific remediation goals developed in the FS. The areas of concern and soil hot spots for OU2 include:

- Contaminated soil above risk-based levels

- Contaminated soil above performance standards based on protection of groundwater (i.e., S-3 target concentration RGOs)

- Contaminated groundwater above performance standards (i.e., MCLs and state groundwater standards)

Figures 6-1 and 6-2 showed the locations where organic and inorganic constituents, respectively, in soil exceed RGOs based on protection of groundwater. Figure 6-3 showed the surficial aquifer well locations where contaminant concentrations exceed MCLs or state groundwater standards. These standards are exceed in most of the surficial aquifer beneath OU2. Only three locations had contaminant concentrations that resulted in an HI above 1.0 for the future hypothetical residential scenario; however, these are not presented on a separate map because future residential use of OU2 is extremely unlikely. Table 9-1 summarizes the remedial objectives for soil and groundwater. A concise description of how each alternative will address contamination at OU2 as well as estimated cost follows.

9.1 GROUNDWATER ALTERNATIVES

9.1.1 Groundwater Alternative 1 - No Action

The No Action Alternative is required under CERCLA to establish a baseline for comparison. Under this alternative, no actions will be performed to contain, remove, or treat groundwater contaminated above performance standards. There are no capital or annual operation and maintenance (O&M) costs associated with this alternative.

9.1.2 Groundwater Alternative 2 - Natural Attenuation and Institutional Controls

Under Groundwater Alternative 2, institutional controls will be imposed to eliminate or reduce pathways of exposure to contaminants at OU2. In addition, groundwater monitoring and surface water monitoring will be conducted.

Natural attenuation refers to inherent processes that affect the rate of migration and concentration of chemicals in groundwater. The most important processes are biodegradation, advection, hydrodynamic dispersion, dilution from recharge, sorption,and volatilization.

TABLE 9-1

REMEDIAL ACTION OBJECTIVES
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Objective	Location	Estimated Volume	Rationale
Protect groundwater from leachable organics	Area 1 (locations B1, B2, B3/B4, B5/B6, 10B01, 10B02, 10B03, 10B04, 10SISB1, 10SISB3, and 10SISB4)	6,200 CY	Organic compounds above performance standards.
	Area 2 (locations 10SB-E63 and 10TP15)	260 CY	Organic compounds above performance standards.
	Area 3A (location 10TP18)	560 CY	Organic compounds above performance standards.
	Area 3B (locations OU2SB05, OU2SB07, and OU2SB08)	370 CY	Organic compounds above performance standards.
	Area 4 (locations 10SB-B5, 10TP02, and 10TP14	370 CY	Organic compounds above performance standards.
	Other areas (isolated locations - see Figure 6-1)	930 CY	Organic compounds above performance standards.
Protect groundwater from leachable inorganics	Isolated areas (see Figure 6-2)	2,700 CY	Metals above performance standards.
Groundwater (surficial aquifer)	Entire site	220 Million Gallons	Organics and metals above performance standards.

The institutional controls would involve groundwater and aquifer use restrictions. All groundwater beneath OU2 would be restricted from any use, other than monitoring purposes. No wells would be installed, except for monitoring wells constructed pursuant to 15A NCAC 2C.O108 as determined by NCDENR.

Monitoring would consist of sampling of groundwater and surface water and sediment in Slocum Creek and Turkey Gut. The objectives of monitoring would be to determine the effectiveness of the remedy and to confirm that contaminants are not migrating off site.

The estimated net present worth of this alternative is $729,000, with no capital cost and an annual operation and maintenance (O&M) cost of $43,800 over 30 years.

9.1.3 Groundwater Alternative 3 - Groundwater Extraction; Treatment and Discharge to Slocum Creek or Pretreatment and Discharge to Sewage Treatment Plant (STP); Institutional Controls

9.1.3.1 Groundwater Alternative 3A - Groundwater Extraction; Treatment and Discharge to Slocum Creek; Institutional Controls

Groundwater Alternative 3A will involve the same institutional controls and media monitoring as discussed in Groundwater Alternative 2. In addition, a groundwater extraction and treatment system would be installed to contain the contaminants in the surficial aquifer by restricting lateral and vertical migration of the groundwater.

The groundwater extraction system would consist of wells installed in the surficial aquifer near the boundaries of Slocum Creek and Turkey Gut. Groundwater extraction would continue until the performance standards for each of the contaminants of concern are achieved.

The treatment of contaminated groundwater will involve physical and chemical treatment. The groundwater would be treated to levels that attain state surface water standards for Slocum Creek or NPDES discharge limits that would be established. The treated groundwater would be discharged directly to Slocum Creek.

The estimated time to implement this alternative is one to two years. Modeling studies have indicated that it would take approximately 60 years to attain most performance standards. The estimated net present worth of this alternative is $10.5 million, with a capital cost of $4.3 million and an annual O&M cost of $395,000 over 30 years.

9.1.3.2 Alternative 3B - Groundwater Extraction; Pretreatment and Discharge to STP; Institutional Controls

Groundwater Alternative 3B is similar to Groundwater Alternative 3A except that extracted groundwater would be pretreated and discharged to the STP instead of Slocum Creek. Pretreatment of extracted groundwater would be less rigorous but would include physical and chemical treatment. The groundwater would be pretreated to levels that meet STP influent requirements, which are the same as the STP effluent discharge limits. The pretreated groundwater would be discharged to the STP.

The estimated time to implement this alternative is one to two years. Modeling studies have indicated that it would take approximately 60 years to attain most performance standards. The estimated net present worth of this alternative is $5.3 million, with a capital cost of $2.2 million and an annual O&M cost of $198,000 over 30 years.

9.1.4 Groundwater Alternative 4 - Air Sparging/Soil Vapor Extraction; Institutional Controls

Groundwater Alternative 4 would involve the same institutional controls and media monitoring as discussed in Groundwater Alternative 2. In addition, an in-situ groundwater treatment system would be installed to remove volatile organic compounds (VOCs) from the surficial aquifer.

Groundwater contaminated with VOCs would be treated in-situ using air sparging/soil vapor extraction (AS/SVE) technologies. The AS/SVE system would consist of a series of injection wells screened near the bottom of the aquifer and a series of extraction wells screened in the vadose zone above the water table. Extracted air, which would contain the VOCs removed from the groundwater, would be treated, if necessary, prior to discharge to the atmosphere.

The estimated time to implement this alternative is less than one year. Modeling studies have indicated that it would take approximately 11 years to attain performance standards for VOCs. It would take approximately 60 years to attain performance standards for most other contaminants. The estimated net present worth of this alternative is $4.5 million, with a capital cost of $2.1 million and an annual O&M cost of $248,000 over 30 years.

9.2 SOIL ALTERNATIVES

9.2.1 Soil Alternative 1 - No Action

The No Action Alternative is required under CERCLA to establish a baseline for comparison. Under this alternative, no actions would be taken to contain, remove, or treat soil contaminated above performance standards. There are no capital or annual O&M costs associated with this alternative.

9.2.2 Soil Alternative 2 - Institutional Controls

Under Soil Alternative 2, institutional controls would be imposed to eliminate or reduce pathways of exposure to soil contaminants and buried waste at OU2. In addition, a monitoring program would be implemented.

The institutional controls would involve land use restrictions and designation of the area as a restricted or limited use industrial area. The land use at OU2 would be restricted to industrial uses only. Prohibited land uses include, but would not be limited to, residences, schools, playgrounds, day cares, and retirement centers. No intrusive activities (e.g., excavation of ground surface or insertion of objects into the ground surface, except for monitoring purposes) would be allowed, unless prior approval has been obtained from USEPA and NCDENR. Site access would be restricted to authorized personnel only. Site access controls would include the installation of a fence around the polishing ponds, repair and replacement of existing fencing around the OU2 landfill, and the placement of warning signs along the fence, Slocum Creek, and Turkey Gut to warn all unauthorized persons to stay out.

Monitoring would consist of sampling of groundwater and surface water and sediment in Slocum Creek and Turkey Gut. The objectives of monitoring would be to confirm that contaminants are not migrating to groundwater or surface water.

The estimated net present worth of this alternative is $800,000, with a capital cost of $70,900 and an annual O&M cost of $43,800 over 30 years.

9.2.3 Soil Alternative 3 - Soil Vapor Extraction; Institutional Controls

Soil Alternative 3 would involve the same institutional controls and media monitoring as discussed in Soil Alternative 2. In addition, soil containing VOCs at concentrations greater than the performance standards and that constitute a secondary source area would be treated in-situ using soil vapor extraction (SVE).

The SVE systems at the secondary source areas would use wells screened in the vadose zone for capture and extraction of VOCs from the soil. Extracted air, contaminated with VOCs, would be treated using an aboveground off-gas treatment system, if required. Air monitoring and soil sampling would be implemented to evaluate the effectiveness of treatment.

The estimated time to implement this alternative is less than one year. The estimated net present worth of this alternative is $1.5 million, with a capital cost of $720,000 and an annual O&M cost of $91,400 over 30 years.

9.2.4 Soil Alternative 4 - Excavation, Consolidation, and Containment; Institutional Controls

Soil Alternative 4 includes the same institutional controls and media monitoring as Soil Alternative 2. In addition, soil contaminated at levels higher than performance standards would be excavated, consolidated, and capped using a multilayer cap to reduce the migration of soil contaminants due to infiltration, surface water runoff, and wind erosion.

Soil with concentrations higher than the performance standards for various organic and inorganic contaminants would be excavated and placed in a consolidation area. To minimize excavation and transportation requirements, the consolidation area would be the largest single area of contaminated soil. This area is located approximately 150 feet south of the former sludge application area (Site 44A) in the vicinity of the former sludge impoundments.

The consolidation area would be covered with a multi-layer cap to contain the contaminated soil to minimize infiltration and erosion. The consolidation area would be closed as a landfill in accordance with the requirements of RCRA Subtitle C and 15A NCAC 13A. The cap would cover an area of approximately 0.5 acre.

The estimated time to implement this alternative is less than one year. The estimated net present worth of this alternative is $1.9 million, with a capital cost of $1.2 million and an annual O&M cost of $43,800 over 30 years.

9.2.5 Soil Alternative 5 - Excavation, Treatment and Onsite Disposal; Institutional Controls

Soil Alternative 5 includes the same institutional controls and media monitoring as Soil Alternative 2. In addition, soil contaminated at levels higher than the performance standards would be excavated and treated, based on the contaminants of concern, to immobilize and/or remove contaminants. Metals contamination

in the soil would be immobilized using chemical fixation/solidification technologies that bind the chemical to a solid matrix which is resistant to leaching. Soil contaminated with volatile organics would be treated using thermal desorption technologies. These technologies use indirect or direct heating of the soil to thermally desorb or volatilize organic contaminants. Off-gas from the process would be treated through a secondary treatment system if needed.

Soil that exceeds performance standards for volatile organic contaminants and soil that exceeds performance standards for inorganic and nonvolatile organic contaminants would require excavation and treatment. The soil that contains inorganics and nonvolatile organics would be treated using a cement-based solidification process. The solidified soil would be placed in a consolidation area and capped. The cap design is the same as for Soil Alternatives 4. Soil that contains volatile organics would be treated using low-temperature thermal desorption. The thermally treated soil would be used as general backfill.

The estimated time to implement this alternative is one year. The estimated net present worth of this alternative is $5.4 million, with a capital cost of $4.7 million and an annual O&M cost of $43,800 over 30 years.

9.2.6 Soil Alternative 6 - Excavation and Offsite Disposal; Institutional Controls

Soil Alternative 6 includes the same institutional controls and media monitoring as Soil Alternative 2. In addition, soil contaminated at levels higher than the performance standards would be excavated and disposed off site.

Soil contaminated at levels higher than the performance standards would be excavated and hauled to an offsite landfill. Based on previous testing, the contaminated soil would not be classified as a RCRA hazardous waste. Clean fill would be placed and compacted in the excavated areas. Topsoil would be placed on top of the compacted fill, and the areas would be revegetated.

The estimated time to implement this alternative is one year. The estimated net present worth of this alternative is $3.5 million with a capital cost of $2.8 million and an annual O&M cost of $43,800 over 30 years.

9.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The remedial action for OU2, under CERCLA Section 121(d), must comply with Federal and state environmental laws that are either applicable or relevant and appropriate. Applicable requirements are those

standards, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those that, while not applicable, still address problems or situations sufficiently similar to those encountered on site that their use is well-suited to a particular site. To-be-considered (TBC) criteria are nonpromulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary level of cleanup to protect health or the environment. While TBCs do not have the status of ARARs, the approach to determining whether a remedial action is protective of human health and the environment involves considering TBCs along with ARARs.

The affected groundwater in the aquifers beneath OU2 has been classified by North Carolina and USEPA and Class GA and Class 2A, a potential source of drinking water, respectively. It the policy of North Carolina and USEPA that groundwater resources be protected and restored to their beneficial uses. North Carolina groundwater classification is defined in 15A NCAC 2L. A complete definition of for the USEPA groundwater classification is provided in the Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy, Final Draft, December 1986.

Contaminant-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Examples of chemical-specific ARARs include the MCLs specified under the Safe Drinking Water Act and North Carolina groundwater standards. Since there are usually numerous chemicals of concern for any remedial site, various numerical quantity requirements can be ARARs. Table 9-2 lists potential contaminant-specific ARARs for OU2.

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Examples of location-specific ARARs include state and Federal requirements to protect floodplains, critical habitats, and wetlands and solid and hazardous waste facility siting criteria. Table 9-3 summarizes the potential location-specific ARARs for OU2.

Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. Since there are usually several alternative actions for any remedial site, very different requirements can be ARARs. Table 9-4 lists potential action-specific ARARs and TBCs for OU2.

TABLE 9-2

POTENTIAL CONTAMINANT-SPECIFIC ARARs
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Citation	Description	Category
Safe Drinking Water Act		
40 CFR 141 - National Primary Drinking Water Standards	Establishes MCLs which are health-based standards for public water systems.	R&A
	Establishes MCLGs set at levels of no known or anticipated adverse health effects.	R&A
Clean Water Act		
40 CFR 131 - Ambient Water Quality Standards	Suggested ambient standards for the protection of human health and aquatic life.	R&A
Clean Air Act		
40 CFR 50 - National Primary and Secondary Ambient Air Quality Standards	Establishes standards for ambient air quality to protect public health.	R&A
Resource Conservation and Recovery Act		
40 CFR 264, Subpart F - Releases from Solid Waste Management Units	Establishes groundwater protection standards.	A
State of North Carolina Regulations		
15A NCAC 2D .0400 - Ambient Air Quality Standards	Establishes standards for ambient air quality to protect human health.	R&A
15A NCAC 2B - Surface Water Classifications and Standards	Establishes water quality standards for all waters of the state	A
15A NCAC 2L - Groundwater Quality Standards	Establishes minimum water quality standards for groundwater.	A
15A NCAC 18 - Water Quality Standards	Establishes MCLs for drinking water.	R&A
(Draft) North Carolina Risk Analysis Framework	Establishes cleanup levels for contaminants in soil and groundwater.	TBC

A - Applicable
R&A - Relevant and appropriate
TBC - To-Be-Considered Criteria

TABLE 9-3

POTENTIAL LOCATION-SPECIFIC ARARs
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Citation	Description	Category
Executive Order 11990 Wetlands Protection Policy	Requires Federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to enhance their natural and beneficial values. Wetlands are located along Slocum Creek and Turkey Gut.	TBC
Endangered Species Act (16 USC 1531/40 CFR 502)	Requires Federal agencies to ensure that any action authorized,funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or adversely affect its critical habitat.	R&A
Fish and Wildlife Coordination Act (16 USC 661)	Requires Federal agencies to consult with appropriate state agency for the modification of any body of water.	R&A
Fish and Wildlife Improvement Act (16 USC 742a) and Fish and Wildlife Conservation Act (16 USC 2901)	Provide for consideration of the impacts on wetlands and protected habitats. Wetlands are located along Slocum Creek and Turkey Gut.	R&A
EPA Groundwater Protection Strategy	This policy is to protect groundwater for its highest usage.	TBC
North Carolina Coastal Area Management Act (15A NCAC 7)	Provides guidelines for areas of environmental concern, including estuarine waters and estuarine shorelines.	R&A

R&A - Relevant and Appropriate
TBC - To-be-considered Criteria

TABLE 9-4

POTENTIAL ACTION-SPECIFIC ARARs
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Citation	Description	Category
Resource Conservation and Recovery Act		
40 CFR 261 - Identification and Listing of Hazardous Wastes	Characterization of hazardous wastes	A
40 CFR 262 - Standards Applicable to Generators of Hazardous Waste	General requirements managing hazardous wastes and manifest requirements.	A
40 CFR 263 - Standards Applicable to Transporters of Hazardous Waste	Requirements for offsite transportation of hazardous waste.	A
40 CFR 264 - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	Establishes minimum national standards that define acceptable management of hazardous wastes.	A
40 CFR 268 - Land Disposal Restrictions	Certain classes of hazardous waste are restricted from land disposal without acceptable treatment.	A
Clean Water Act		
40 CFR 122 - National Pollutant Discharge Elimination System	Governs point source discharges to surface water.	R&A
Other Federal Acts and Requirements		
49 CFR 107 and 171-179 - Department of Transportation Rules for Hazardous Materials Transport	Regulates the offsite transportation of hazardous materials (including hazardous and solid waste).	A
29 CFR 1910, 1926, and 1904 - Occupational Safety and Health Administration	Regulates occupational safety and health requirements for workers engaged in remedial activities.	A
State of North Carolina Regulations		
15A NCAC 13A - Solid Waste Management Regulations	Establishes standards for management of solid (nonhazardous) waste.	A
15A NCAC 13B - Hazardous Waste Management Regulations	Establishes standard for management of hazardous waste.	A
15A NCAC 2B and 2H - Water Pollution Control Regulations	Regulates wastewaters discharged to surface water.	A
15A NCAC 2H - Stormwater Runoff Disposal	Regulates pollutants associated with stormwater runoff.	A

TABLE 9-4 (Continued)
POTENTIAL ACTION-SPECIFIC ARARs
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Citation	Description	Category
15A NCAC 4 - Erosion and Sedimentation Control	Establishes standards to control damage from land disturbing activities.	A
15A NCAC 2C - Well Construction Standards	Establishes criteria for design and installation of monitoring wells.	A
15A NCAC 2L.0106 - Corrective Action for Groundwater	Requirements for corrective action when groundwater has been degraded.	A

A - Applicable
R&A - Relevant and appropriate
TBC - To-be-considered criteria

10.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section of the ROD provides the basis for determining which alternative provides the best balance with respect to the statutory balancing criteria in CERCLA Section 121 (42 USC 9621) and in the NCP (40 CFR 300.430). The major objective of the FS was to develop, screen, and evaluate alternatives for remediation of groundwater and soil at OU2. A variety of technologies and alternatives were identified as candidates to remediate the contamination at OU2. These were screened based on their feasibility with respect to the contaminants present and site characteristics. After the initial screening, the remaining alternatives/technologies were combined into potential remedial alternative and evaluated in detail. The remedial alternative was selected from the screening process using the following nine evaluation criteria:

- Overall protection of human health and the environment.
- Compliance with applicable and/or relevant Federal or state public health or environmental standards.
- Long-term effectiveness and permanence.
- Reduction of toxicity, mobility, or volume through treatment.
- Short-term effectiveness
- Implementability
- Cost
- USEPA/State acceptance
- Community acceptance

A glossary of the evaluation criteria is provided in Table 10-1.

TABLE 10-1
GLOSSARY OF EVALUATION CRITERIA

- **Overall Protection of Human Health and Environment** - Addresses whether or not an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- **Compliance with ARARs** - Addresses whether or not an alternative will meet all of the applicable or relevant and appropriate requirements (ARARs), other criteria to be considered (TBCs), or other Federal and state environmental statutes and/or provide grounds for invoking a waiver.

- **Long-term Effectiveness and Permanence** - Refers to the magnitude of residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

- **Reduction of Toxicity, Mobility, or Volume through Treatment** - Addresses the anticipated performance of the treatment options that may be employed in an alternative.

- **Short-term Effectiveness** - Refers to the speed with which the alternative achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment that may result during the construction and implementation period.

- **Implementability** - Addresses the technical and administrative feasibility of an alternative, including the availability of materials and services needed to implement the chosen solution.

- **Cost** - Includes capital and operation and maintenance costs. For comparative purposes, provides present-worth values.

- **USEPA/State Acceptance** - Evaluates the technical and administrative issues and concerns that the USEPA and the State of North Carolina have regarding each of the alternatives. This criterion is addressed in the ROD once comments on the RI/FS report and the Proposed Plan have been received.

- **Community Acceptance** - Evaluates the issues and concerns the public may have regarding each of the alternatives. This criterion is addressed in the ROD once comments on the RI/FS report and Proposed Plan have been received.

The NCP categorizes the nine criteria into three groups:

- Threshold Criteria - Overall protection of human health and the environment and compliance with ARARs (or invoking a waiver) are threshold criteria that must be satisfied in order for an alternative to be eligible for selection.

- Primary Balancing Criteria - Long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost are primary balancing factors used to weigh major trade-offs among alternative hazardous waste management strategies.

- Modifying Criteria - USEPA/State and community acceptance are modifying criteria that are formally taken into account after public comments are received on the proposed plan and incorporated in the ROD.

The selected alternative must meet the threshold criteria and comply with all ARARs or be granted a waiver for compliance with ARARs. Any alternative that does not satisfy both of these requirements is not eligible for selection. The Primary Balancing Criteria are the technical criteria upon which the detailed analysis of alternatives is primarily based. The final two criteria, known as Modifying Criteria, assess the acceptance of the alternative. The following analysis summarizes the evaluation of alternatives for remediating groundwater and soil at OU2 under each criterion. Each groundwater alternative and each soil alternative is compared for achievement of a specific criterion.

Tables 10-2 and 10-3 present summaries of the detailed analysis for groundwater and soil, respectively.

10.1 THRESHOLD CRITERIA

All alternatives considered for selection must comply with the threshold criteria of overall protection of human health and the environment and compliance with ARARs.

10.1.1 Overall Protection of Human Health and the Environment

This criterion evaluates, overall, the degree of protectiveness afforded to human health and the environment. It assess the overall adequacy of each alternative. For all alternatives, the waste buried in the landfill would remain and may act as a continuing source of contamination that could not feasibly be removed.

10.1.1.1 Groundwater Alternatives

Groundwater concentrations exceed state standards and pose an unacceptable risk to human health from ingestion under a hypothetical future residential exposure scenario.

Groundwater Alternative 1 does not reduce potential risks to human health and the environment; therefore, this alternative is not protective and will no longer be considered in the discussion.

Groundwater Alternatives 2, 3, and 4 would employ institutional controls, with monitoring, to reduce the unacceptable risks to human health from ingestion of groundwater. The sampling and analysis program would confirm that contaminants are not migrating from the site, and institutional controls would prohibit residential use and installation of wells (except monitoring wells).

TABLE 10-2

SUMMARY OF EVALUATION OF GROUNDWATER ALTERNATIVES
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Evaluation Criteria	Groundwater Alternative 1: No Action	Groundwater Alternative 2: Natural Attenuation, Institutional Controls, and Monitoring	Groundwater Alternative 3: Groundwater Extraction; Treatment and Discharge to Slocum Creek or Pretreatment and Discharge to STP; Institutional Controls
Threshold Criteria			
Overall Protection of Human Health and Environment	No reduction in potential risks except through natural attenuation of the groundwater.	Natural attenuation, institutional controls, and monitoring will reduce potential risks to human health and the environment under realistic exposure scenarios.	Institutional controls and monitoring provide some protection of human health and the environment. Groundwater containment using extraction wells provides some additional protection.
Compliance with ARARs Chemical-Specific ARARs	No active effort to reduce contaminant levels to below federal or state ARARs.	Would comply with state groundwater requirements.	Would comply with state groundwater requirements.
Location-Specific ARARs	Not applicable.	Not applicable.	Can be designed to attain ARARs that apply.
Action-Specific ARARs	Not applicable.	Not applicable.	Can be designed to attain ARARs that apply.
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	Allows risk to remain uncontrolled.	Monitoring and use restrictions provide adequate and reliable controls.	Removal of contaminated groundwater will reduce site hazards to potential land users. Institutional controls will further limit risks.
Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment.	No treatment.	The volume and toxicity of contaminated groundwater would be reduced through active remediation. Residuals created that require disposal.
Short-Term Effectiveness	Not applicable, no short term impacts/concerns at site.	Minor risks to workers involved in monitoring of groundwater, surface water, and sediment. No impacts to community upon implementation of institutional controls. Less than one year to implement.	Proper system management will limit short term hazards associated with contaminated media treatment. Groundwater RGOs achieved in about 60 years. One to two years to implement.
Implementability	Nothing to implement. No monitoring to show effectiveness.	Enforcement of institutional controls at military site is proven to be effective and reliable. Monitoring will demonstrate effectiveness.	Alternative consists of common treatment practices, which are readily available/implementable. Monitoring will demonstrate effectiveness.
Costs:			Slocum Creek / STP
Capital	$0	$0	$4,340,000 / $2,181,000
O&M	$0	$43,800	$395,000 / $198,000
NPW	$0	$729,000	$10,466,000 / $5,278,000
Modifying Criteria			
USEPA/State Acceptance	Not acceptable to USEPA and NCDENR.	Acceptable to USEPA and NCDENR.	Acceptable to USEPA and NCDENR.

TABLE 10-2 (Continued)
SUMMARY OF EVALUATION OF GROUNDWATER ALTERNATIVES
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Evaluation Criteria	Groundwater Alternative 4: Air Sparging/Soil Vapor Extraction; Institutional Controls
Threshold Criteria	
Overall Protection of Human Health and Environment	Institutional controls and monitoring provide some protection to human health and the environment. Groundwater treatment using AS/SVE provides some additional protection.
Compliance with ARARs	Would comply with state groundwater requirements.
Chemical-Specific ARARs	
Location-Specific ARARs	Can be designed to attain ARARs that apply.
Action-Specific ARARs	Can be designed to attain ARARs that apply.
Primary Balancing Criteria	
Long-term Effectiveness and Permanence	In-situ treatment of contaminated groundwater will reduce site hazards to potential land users. Institutional controls will further limit risks.
Reduction of Toxicity, Mobility, or Volume through Treatment	Active remediation will reduce the volume and toxicity of contaminated groundwater. Residuals generated that require disposal.
Short-term Effectiveness	Proper system management will limit short term hazards associated with contaminated media treatment and potential exposure to workers during alternative implementation. Groundwater RGOs achieved in about 60 years. Two to three years to implement.
Implementability	Alternative consists of common treatment practices, which are readily available/implementable. Monitoring will demonstrate effectiveness.
Costs	
Capital	$2,089,000
O&M	$248,000
NPW	$4,514,000
Modifying Criteria	
USEPA/State Acceptance	Acceptable to USEPA and NCDENR.

TABLE 10-3

SUMMARY OF EVALUATION OF SOIL ALTERNATIVES
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Evaluation Criteria	Soil Alternative 1: No Action	Soil Alternative 2: Institutional Controls and Monitoring	Soil Alternative 3: Soil Vapor Extraction; Institutional Controls
Threshold Criteria			
Overall Protection of Human Health and the Environment	No reduction in potential risks.	Institutional controls and monitoring will prevent unacceptable risks to human health by eliminating exposure to contaminants.	Institutional controls and monitoring will prevent unacceptable risks to human health by eliminating exposure to contaminants . Treatment of major secondary source areas will provide protection of groundwater and surface water.
Compliance with ARARs Chemical-Specific ARARs	No active effort to reduce contaminant levels to attain ARARs.	No active effort to reduce contaminant levels to attain ARARs.	Would only comply with S-3 target concentrations for volatile organics.
Location-Specific ARARs	Not applicable.	Not applicable.	Can be designed to attain ARARs that apply.
Action-Specific ARARs	Not applicable.	Not applicable.	Can be designed to attain ARARs that apply.
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	Allows risks to remain uncontrolled.	Monitoring and use restrictions provide adequate and reliable controls.	Removal of volatile organics from secondary source areas will reduce risks to the environment. Monitoring and use restrictions provide adequate and reliable controls.
Reduction of Toxicity, Mobility, and Volume Through Treatment	No treatment.	No treatment.	Toxicity reduced by removal of volatile organics from major secondary sources areas. No reduction of mobility or volume. Residuals created that require disposal.

TABLE 10-3 (Continued)
SUMMARY OF EVALUATION OF SOIL ALTERNATIVES
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Evaluation Criteria	Soil Alternative 1: No Action	Soil Alternative 2: Institutional Controls and Monitoring	Soil Alternative 3: Soil Vapor Extraction; Institutional Controls
Short-Term Effectiveness	Not applicable. No short-term impacts or concerns.	Minor risks to workers involved in installation of fencing and warning signs and monitoring of groundwater, surface water, and sediment. No impacts to community or environment. Less than one year to implement.	Proper system management will limit short-term hazards associated with contaminated media treatment. Minor risks to workers involved in installation of fencing and warning signs and monitoring of groundwater, surface water, and sediment. No impacts to community or environment. Potential risks from air emissions can be adequately controlled. SVE systems are expected to operate for one to two years.
Implementability	Nothing to implement. No monitoring to show effectiveness.	Alternative is readily implementable.	Alternative consists of common treatment practices, which are readily available and implementable. Treatability study may be necessary.
Costs: Capital O&M NPW	 $0 $0 $0	 $70,900 $43,800 $800,000	 $720,000 $91,400 $1,538,000
Modifying Criteria			
USEPA/State Acceptance	Not acceptable to USEPA or NCDENR.	Not acceptable to USEPA and NCDENR.	Acceptable to USEPA and NCDENR.

TABLE 10-3 (Continued)
SUMMARY OF EVALUATION OF SOIL ALTERNATIVES
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Evaluation Criteria	Soil Alternative 4: Excavation, Consolidation, and Containment; Institutional Controls	Soil Alternative 5: Excavation, Treatment, and Onsite Disposal; Institutional Controls	Soil Alternative 6: Excavation and Offsite Disposal; Institutional Controls
Threshold Criteria			
Overall Protection of Human Health and the Environment	Institutional controls and monitoring will reduce potential risks to human health and the environment. Consolidation and containment of all secondary source areas will provide additional protection of groundwater and surface water.	Institutional controls and monitoring will reduce potential risks to human health and the environment. Removal of volatile organics from and stabilization and capping of all secondary source areas will provide additional protection of groundwater and surface water.	Institutional controls and monitoring will reduce potential risks to human health and the environment. Removal of all secondary source areas will provide additional protection of groundwater and surface water.
Compliance with ARARs Chemical-Specific ARARs Location-Specific ARARs Action-Specific ARARs	Would comply with S-3 target concentrations for volatile organics and metals. Can be designed to attain ARARs that apply. Can be designed to attain ARARs that apply.	Would comply with S-3 target concentrations for volatile organics and metals. Can be designed to attain ARARs that apply. Can be designed to attain ARARs that apply.	Would comply with S-3 target concentrations for volatile organics and metals. Can be designed to attain ARARs that apply. Can be designed to attain ARARs that apply.
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	Containment of contaminants from all secondary source areas will reduce risks to the environment. Monitoring and use restrictions provide adequate and reliable controls.	Treatment of contaminants from all secondary source areas will reduce risks to the environment. Monitoring and use restrictions provide adequate and reliable controls.	Removal of all secondary source areas will reduce risks to the environment. Monitoring and use restrictions provide adequate and reliable controls.
Reduction of Toxicity, Mobility, and Volume Through Treatment	Mobility reduced by containment of all contaminants from secondary source areas beneath a cap. No reduction of toxicity or volume.	Toxicity reduced by removal of volatile organics from all secondary source areas. Residuals created that require disposal. Mobility reduced by solidification of secondary source areas contaminated with non-volatile organics and metals. Volume would increase.	No treatment.

TABLE 10-3 (Continued)
SUMMARY OF EVALUATION OF SOIL ALTERNATIVES
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Evaluation Criteria	Soil Alternative 4: Excavation, Consolidation, and Containment; Institutional Controls	Soil Alternative 5: Excavation, Treatment, and Onsite Disposal; Institutional Controls	Soil Alternative 6: Excavation and Offsite Disposal; Institutional Controls
Short-Term Effectiveness	Proper system management will limit short-term hazards associated with containment of contaminated media. Minor risks to workers involved in installation of fence and warning signs and monitoring of groundwater, surface water, and sediment. No impacts to community or environment. Less than one year to implement.	Proper system management will limit short-term hazards associated with contaminated media treatment. Minor risks to workers involved in installation of fence and warning signs and monitoring of groundwater, surface water, and sediment. No impacts to community or environment. Less than one year to implement.	Proper system management will limit short-term hazards associated with handling of contaminated media. Minor risks to workers involved in installation of fence and warning signs and monitoring of groundwater, surface water, and sediment. No impacts to community or environment. Less than one year to implement.
Implementability	Alternative consists of common remediation practices, which are readily available and implementable.	Alternative consists of common treatment and remediation practices, which are readily available and implementable. Treatability study may be required.	Alternative consists of remediation practices, which are readily available and implementable.
Costs: Capital O&M NPW	 $1,214,000 $43,800 $1,943,000	 $4,713,000 $43,800 $5,442,000	 $2,808,000 $43,800 $3,537,000
Modifying Criteria			
USEPA/State Acceptance	Acceptable to USEPA and NCDENR.	Acceptable to USEPA and NCDENR.	Acceptable to USEPA and NCDENR.

Groundwater Alternative 2 relies on natural attenuation processes to reduce organic and inorganic contaminant concentrations that exceed state groundwater standards and pose an unacceptable risk to human health from ingestion. Groundwater Alternatives 3 and 4 involve active groundwater remediation systems that provide additional protection of the environment by preventing migration of contaminated groundwater to surface water, which could result in exceedances of state surface water standards. Groundwater Alternative 3 would remove organics and inorganics. Groundwater Alternative 4 would remove mainly volatile organics.

10.1.1.2 Soil Alternatives

Soil concentrations exceed levels based on protection of groundwater and pose an unacceptable risk to human health under a hypothetical future residential exposure scenario.

Soil Alternative 1 does not reduce potential risks to human health and the environment; therefore, it is not protective and will no longer be considered in this discussion. Soil Alternative 2 does not reduce potential risks to the environment because soil concentrations would exceed levels based on protection of groundwater; therefore, it is not protective and will no longer be considered in this discussion.

Soil Alternatives 3, 4, 5, and 6 would employ institutional controls, with monitoring, to reduce risks to human health from exposure to contaminated soil and buried waste material. The sampling and analysis program would confirm that contaminants are not migrating to the environment. Institutional controls would limit site access and prohibit residential use and invasive construction activities.

Soil Alternatives 3 and 5 involve soil treatment that protects the environment by removing soil contaminants that could migrate to groundwater and surface water and cause an exceedance of state standards. Soil Alternatives 4 and 5 involve containment of untreated or solidified contaminated soil which protects the environment by reducing the potential for migration of contaminants to groundwater and surface water. Soil Alternative 6 involves removal and offsite disposal of soil which protects the environment by eliminating the potential for migration to groundwater and surface water.

10.1.2 Compliance with ARARs

10.1.2.1 Groundwater Alternatives

Groundwater Alternatives 2, 3, and 4 will meet all of their respective ARARs. Groundwater ARARs include North Carolina groundwater standards and MCLs that establish chemical-specific limits on certain contaminants in groundwater and community water systems, respectively.

Groundwater Alternative 2 would eventually comply with ARARs through natural attenuation, otherwise a

waiver of state groundwater standards is needed or the surficial aquifer could be reclassified from drinking water (Class GA) to either restricted designation (Class RS) or water supplies for purposes other than drinking (Class GC).

Groundwater Alternative 3 would actively remove organics and inorganics. Groundwater Alternative 4 would remove mainly volatile organics; other contaminants would be removed by natural attenuation.

Groundwater Alternatives 2, 3, and 4 would be able to meet all of the location- and action-specific ARARs that apply to them.

For all groundwater alternatives, waste buried in the landfill would continue to be a potential source of groundwater contamination. The volume of buried waste is substantially greater than the volume of soil "hot spot" soil that would be addressed under one of the remedial alternatives for soil.

10.1.2.2 Soil Alternatives

Soil Alternatives 3, 4, 5, and 6 would meet all of their respective ARARs. Soil ARARs include North Carolina S-3 target concentrations (TBC criteria) that establish chemical-specific limits on contaminants based on protection of groundwater. Soil Alternatives 3, 4, 5, and 6 would be able to meet all location- and action-specific ARARs, except as noted below.

10.2 PRIMARY BALANCING CRITERIA

10.2.1 Long-Term Effectiveness and Permanence

The main concerns under this criterion are the reliability of controls over the residual risks associated with contaminants that remain at the site and the permanence of the effectiveness of each alternative. Although residual risks associated with environmental media will be minimal under realistic exposure scenarios, untreated waste (landfill waste) will remain at the site under all alternatives. Until such time that no residual risk remains at the site, all alternatives will require five-year reviews to ensure that adequate protection of human health and the environment is maintained.

Groundwater Alternative 3 is the most effective, because all contaminants would be actively removed from the surficial aquifer. Groundwater Alternative 4 is less effective than Alternative 3, because only volatile organics would be actively removed. Groundwater Alternative 2 is the least effective, because contamination would not be actively removed. However, natural attenuation processes would effectively remove contaminants not removed by active remediation processes. Groundwater Alternatives 2, 3, and 4 provide continued monitoring, aquifer use restrictions, and land use restrictions which are all adequate and reliable

controls. The monitoring programs are used to determine that the alternatives remain effective.

Soil Alternative 6 is the most effective, because all contaminants that exceed RGOs would be removed from the site and be disposed off site. Soil Alternative 5 is less effective than Alternative 6, because only organic compounds would be removed by treatment; however, the mobility of the remaining contaminants would be reduced using solidification and capping. Soil Alternative 3 is less effective than Alternative 5 because only volatile (and some semivolatile) organic compounds would be removed. Soil Alternative 4 is the least effective, because contaminants would be contained beneath a cap rather than being removed. Soil Alternatives 3, 4, 5, and 6 provide continued monitoring, fencing, and land use restrictions which are all adequate and reliable controls. The containment, treatment, and removal components of these alternatives are well-proven technologies that would provide adequate performance.

Barring remediation of contamination to unrestricted exposure levels, any private ownership of the land in the future would be controlled under a restrictive covenant.

10.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

The criterion addresses the reduction in toxicity, reduction in mobility, or reduction of volume of contaminants provided through treatment processes.

Groundwater Alternative 2 does not involve active treatment processes to reduce toxicity, mobility, or volume.

Groundwater Alternatives 3 and 4 use active groundwater treatment to reduce toxicity, mobility, or volume. Alternative 3 uses physical/chemical treatment following groundwater extraction, and Alternative 4 uses in-situ AS/SVE. Both of these alternatives satisfy the CERCLA statutory preference for treatment.

Soil Alternatives 4 and 6 do not involve active treatment processes to reduce toxicity, mobility, or volume.

Soil Alternative 3 uses soil vapor extraction to remove volatile organics, thereby reducing toxicity and mobility. Soil Alternative 5 uses thermal desorption to remove volatile organics, thereby reducing toxicity and mobility. This alternative also uses solidification to reduce mobility; however, there would be an increase in volume. Both of these alternative satisfy the CERCLA statutory preference for treatment.

10.2.3 Short-Term Effectiveness

The main concern for this criterion would be potential effects to the remedial workers, community, and environment during implementation of the remedial action. An additional concern is the time for each alternative to achieve the remedial action objectives.

No risks to the community or environment are anticipated for any of the groundwater or soil alternatives. Groundwater Alternatives 3 and 4 create some risks to workers during installation of extraction wells, treatment plants, and the AS/SVE system. Soil Alternatives 3, 4, 5, and 6 also create risks to workers during excavation, handling, consolidation, and treatment of contaminated soils. All potential risks to workers can be adequately controlled.

The institutional controls component of all alternatives could be implemented in less than one year.

The time in which Groundwater Alternatives 2, 3, and 4 will achieve the remedial action objectives for surficial aquifer groundwater is estimated to be 11 years for organics and 60 years for metals. The time to achieve the performance standards cannot be accurately estimated because the contribution from the primary source of contamination (buried waste) is unknown. Evaluation of future monitoring results may allow for an estimate of the effect of landfill material on groundwater remediation times.

The SVE systems for Soil Alternative 3 are expected to achieve the performance standards in one to two years. For Soil Alternatives 4, 5, and 6, the excavation, consolidation, capping, treatment, and offsite disposal activities could be implemented in less than one year.

10.2.4 Implementability

The major concerns in the category consist of the ease of implementation, including availability of equipment and services, the technical complexity of the processes, and the ease of obtaining permits or approvals.

Groundwater Alternatives 2, 3, and 4 use conventional, well-demonstrated, and commercially available technologies that are reliable and readily implementable. For Groundwater Alternative 3, it may be more difficult to implement the discharge to Slocum Creek option. The treatment system for discharge to Slocum Creek would be more complex than for discharge to the sewage treatment plant.

Soil Alternatives 3, 4, 5, and 6 also use conventional, well-demonstrated, and commercially available technologies that are reliable and readily implementable. Soil Alternatives 3 and 5 present certain additional concerns because treatability studies would probably be required. Soil Alternatives 3, 4, 5, and 6 require verification of soil contamination volumes.

10.2.5 Cost

Cost details are provided in the FS and are summarized in Table 10-4.

TABLE 10-4

COST COMPARISON FOR ALTERNATIVES
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Alternative	Direct and Indirect Costs	Annual O&M Costs	Total Net Present Worth
Groundwater			
Alternative 1	None	None	None
Alternative 2	None	$43,800	$729,000
Alternative 3	$4,340,000(1) $2,181,000(2)	$395,000(1) $198,000(2)	$10,466,000(1) $5,278,000(2)
Alternative 4	$2,089,000	$248,000	$4,514,000
Soil			
Alternative 1	None	None	None
Alternative 2	$70,900	$43,800	$800,000
Alternative 3	$720,000	$91,400	$1,538,000
Alternative 4	$1,214,000	$43,800	$1,943,000
Alternative 5	$4,713,000	$43,800	$5,442,000
Alternative 6	$2,808,000	$43,800	$3,537,000

(1) Discharge to Slocum Creek.
(2) Discharge to Sewage Treatment Plant.

For the groundwater alternatives, Alternative 2 (natural attenuation) has the lowest present worth cost and Alternative 3 (extraction, treatment, and discharge to Slocum Creek) has the highest. The STP discharge option for Alternative 3 and Alternative 4 (AS/SVE) have similar costs. Alternative 3 with discharge to Slocum Creek is significantly more expensive because of the treatment plant construction and operation costs. Groundwater Alternative 2 provides the best ratio of costs to benefit received through the permanent reduction of risks to human health and the environment.

For the soil alternatives, Alternatives 3 (SVE) and 4 (capping) have the lower present worth costs, and Alternative 5 (treatment and onsite disposal) and 6 (offsite disposal) have the highest. Alternatives 5 and 6 are more expensive because of the onsite treatment costs and the offsite transportation and disposal costs, respectively. Soil Alternative 3 provides the best ratio of costs to benefit received through the permanent reduction of risks to human health and the environment.

10.3 MODIFYING CRITERIA

10.3.1 USEPA/State Acceptance

The USEPA and State of North Carolina have concurred with the selection of Groundwater Alternative 2 and Soil Alternative 3 to remediate OU2 (see attached concurrence letters).

10.3.2 Community Acceptance

Based on comments expressed at the July 29, 1997 public meeting and receipt of written comments during the comment period, it appears that the community generally agrees with the selected remedy. Specific responses to issues raised by the community can be found in Section 14, the Responsiveness Summary.

11.0 SELECTED REMEDY

11.1 REMEDY SELECTION

Based upon consideration of the requirements of CERCLA, the NCP, the detailed analysis of alternatives, current and proposed exposure scenarios, and USEPA, state, and public comments, MCAS Cherry Point and the Navy have selected Groundwater Alternative 2 (Natural Attenuation and Institutional Controls) and Soil Alternative 3 (Soil Vapor Extraction and Institutional Controls) for remedial action at OU2. At the completion of this remedy, the risk associated with this site will be protective of human health and the environment.

The selected site-wide alternative for OU2 is consistent with the requirements of Section 121 of CERCLA and the NCP. The selected alternative will reduce the mobility, toxicity, and volume of contaminated soil on site. In addition, the selected site-wide alternative is protective of human health and the environment, will attain Federal and state ARARs (unless a waiver is justified), is cost-effective, and uses permanent solutions to the maximum extent practicable.

Based on the information available at this time, the selected alternatives represent the best balance among the criteria used to evaluate remedies.

The preferred site-wide remedy is anticipated to meet the following objectives:

- Prevent exposure to contaminated soil and buried waste.
- Restrict current and future land use at OU2.
- Prevent exposure to contaminated groundwater at OU2.
- Prevent future potential use of the groundwater at OU2.
- Allow for natural attenuation of the groundwater at OU2.
- Mitigate migration of contaminants from the soil (major secondary source areas) to the environment.

The only unacceptable risks to human health are for the future hypothetical residential exposure. The majority of the risks are due to ingestion of surficial aquifer groundwater and surface soil. All other potential risks to human health under the remaining current and future exposure scenarios are within the USEPA "acceptable" risk range. The future residential exposure pathway for groundwater is extremely unlikely because the surficial aquifer is not used as a source of drinking water, and the Air Station has a separate potable water supply system.

The major components of the site-wide remedy are:

- Natural attenuation of groundwater contaminants will be the means of remediating the groundwater and containing any future releases from the debris remaining in the landfill. Long-term monitoring shall be utilized to confirm the effectiveness of the natural attenuation processes in attaining the performance standards in Table 11-1.

- In-situ treatment using soil vapor extraction at major soil "hot spots" (secondary source areas) that are contaminated with volatile organics and any such areas identified during the Remedial Design. This includes air monitoring and sampling of soil to ensure that the performance standards in Table 11-2 are met.

- Installation of a fence around the polishing ponds and repair and replacement of existing fencing around the OU2 landfill.

- Placement of warning signs along the fence, Slocum Creek, and Turkey Gut to warn potential trespassers to stay out.

- Restriction of the land use at OU2 to industrial uses with the stipulation of no intrusive activities allowed on site, unless prior approval has been obtained from USEPA and NCDENR.

- Restriction of the use of groundwater beneath OU2 to prohibit the installation of any wells, with the only exception being for monitoring wells.

- The creation of a monitoring plan to detail the frequency, type, and locations of the long-term monitoring samples to confirm the effectiveness of natural attenuation processes. There are two objectives that the monitoring will be evaluating. The first objective is to confirm the effectiveness of natural attenuation processes in treating groundwater contamination. The second objective is to insure

TABLE 11-1

GROUNDWATER PERFORMANCE STANDARDS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Contaminant	Performance Standard[1] (µg/kg)
ORGANICS (µg/L	
Benzene	1
Chlorobenzene	50
Chloroform	0.19
1,2-Dichloroethane	0.38
cis-1,2-Dichloroethene	70
1,2-Dichloropropane	0.56
Ethylbenzene	29
2-Hexanone	<DL[2]
4-Methyl-2-pentanone	<DL
Tetrachloroethene	0.7
Trichloroethene	2.8
Vinyl chloride	0.015
Bis(2-chloroethyl)ether	<DL
Bis(2-ethylhexyl)phthalate	3
2,4-Dimethylphenol	<DL
2-Methylnaphthalene	<DL
2-Methylphenol	<DL
4-Methylphenol	<DL
Naphthalene	21
Nitrobenzene	<DL
Aldrin	<DL
alpha-BHC	<DL
4,4'-DDE	<DL
4,4'-DDT	<DL
Endosulfan I	<DL

TABLE 11-1 (Continued)
GROUNDWATER PERFORMANCE STANDARDS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Contaminant	Performance Standard[1] (µg/kg)
Endosulfan II	<DL
Endrin aldehyde	<DL
Heptachlor epoxide	0.004
METALS (µg/L)	
Arsenic	50
Cadmium	5
Iron	300
Manganese	50

(1) North Carolina Class GA Groundwater Standard.
(2) Less than detection limit.

TABLE 11-2

SOIL PERFORMANCE STANDARDS
OPERABLE UNIT 2
MCAS CHERRY POINT, NORTH CAROLINA

Contaminant	Performance Standard[1] (µg/kg)
Benzene	5.6
2-Butanone	687
Chlorobenzene	432
Chloroform	0.96
1,2-Dichloroethane	1.7
cis-1,2-Dichloroethene	350
trans-1,2-Dichloroethene	400
trans-1,3-Dichloropropene	1.2
Ethylbenzene	343
Methylene chloride	21.9
Tetrachloroethene	5.9
Toluene	8,111
1,1,1-Trichloroethane	1,484
Trichloroethene	20.7
Vinyl chloride	0.09
2,4-Dimethylphenol	1,194
2-Methylnaphthalene	3,235
4-Methylphenol	205
Naphthalene	925
Dieldrin	1.8
Heptachlor expoxide	6.7

(1) North Carolina S-3 Target Concentration for Protection of Groundwater.

there are no further releases from the landfill debris still buried at the site that will cause a significant effect.

The records on the presence of contamination at OU2 and the specific restrictions for site use listed above (including land use and groundwater use restrictions) will be recorded in the MCAS Cherry Point Base Master Plan. This will insure that at the time of any future land development, the Air Station will be able to take adequate measures to minimize adverse human health and environmental effects. The USEPA and NCDENR will be properly notified of proposed construction plans at OU2 prior to commencement of any construction activities. Barring remediation to unrestricted exposure levels, any private ownership of the land in the future would be controlled under a restrictive covenant.

The fencing and warning signs will be installed, replaced, and repaired, as necessary, to restrict access to OU2, thereby minimizing human exposure to landfilled wastes. The warning signs will be installed along the fence and the banks of Slocum Creek and Turkey Gut.

Monitoring will consist of the sampling of groundwater in the surficial and Yorktown aquifers to assess the progress of natural attenuation in meeting the groundwater performance standards (i.e., North Carolina groundwater standards) and to confirm that site contaminants are not migrating into the environment. Monitoring will also consist of the sampling of air emissions from the soil vapor extraction systems and soil in the secondary source areas to be treated. The soil sampling results will be compared to the soil performance standards (i.e., North Carolina S-3 target concentrations). Monitoring will also consists of sampling of surface water and sediment in Slocum Creek and Turkey Gut to confirm that site contaminants are not migrating into the environment. The results of surface water monitoring will be compared to North Carolina surface water standards. The results of sediment sampling will be used to confirm that surface soil runoff is not a continuing problem. Slocum Creek is now considered a separate Operable Unit. Monitoring of surface water and sediment in Slocum Creek will be used to further evaluate conditions in Slocum Creek. A monitoring plan will be developed with Federal and State concurrence. Based on the results of the monitoring, additional sampling and analysis and/or remedial actions may be required.

11.2 ESTIMATED COSTS

The estimated net present worth of Groundwater Alternative 2 is $729,000, with no capital cost, an annual O&M cost of $43,800 for 30 years, and a 5-year cost (for the site review) of $20,000. The annual costs are for groundwater, surface water, and sediment monitoring.

The estimated net present worth of Soil Alternative 3 is $1,538,000, with a capital cost of $720,000, an annual O&M cost of $47,600 for 2 years (SVE system), an annual O&M cost of $43,800 (monitoring), and a 5-year cost of $20,000.

It should be noted that the cost estimate was calculated for the FS and should not be considered a construction-quality cost estimate. An FS cost estimate should have an accuracy of +50 or -30 percent. The remedy could change somewhat as a result of the remedial design and construction process. Such changes, in general, reflect modifications resulting from the engineering design process. In addition, the monitoring program will be developed at the remedial design stage and could be revised during the 5-year reviews as a result of evaluation of the data collected.

It should also be noted that the cost estimate does not include the cost to remediate any additional secondary source areas that may be identified during the remedial design.

12.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, the Navy and MCAS Cherry Point must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy for OU2 meets the statutory requirements.

12.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health and the environment by eliminating, reducing, and controlling risk through institutional controls, natural attenuation of groundwater, and in-situ soil treatment. The only "unacceptable" risks posed by OU2 are under a future hypothetical residential exposure scenario. The majority of the risk is from ingestion of contaminated groundwater from the shallow aquifer and surface soil. Land use restrictions would prevent future residential use of the site and invasive construction activities, aquifer use restrictions would prevent the installation of wells (other than for monitoring) and use of contaminated groundwater, and fencing and warning signs would control unauthorized uses of the site. Soil treatment would remove secondary sources of groundwater contamination. Monitoring would provide a means of evaluating future releases of hazardous constituents from landfill materials to the environment, confirming there is no offsite migration of contaminants, and evaluating the effectiveness of natural attenuation and soil treatment. There are no short-term threats associated with the selected remedy that cannot be readily controlled. In addition, no cross-media impacts are expected from the remedy.

12.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Remedial actions performed under CERCLA must comply with all ARARs. All alternatives considered for OU2 were evaluated based on the degree to which they complied with these requirements. The selected remedy was found to meet identified ARARs, unless a waiver was justified, identified in Tables 9-2, 9-3, and 9-4. CERCLA Section 121(d)(4)(C) provides that an ARAR may be waived when compliance is technically impracticable from an engineering perspective. The following is a short narrative in support of attainment of pertinent ARARs.

12.2.1 Contaminant-Specific ARARs

North Carolina Class GA groundwater standards are the groundwater protection standards identified in this ROD as performance standards for remedial action.

12.2.2 Location-Specific ARARs

Performance standards are consistent with ARARs identified in Table 9-3.

12.2.3 Action-Specific ARARs

Performance and treatment standards are consistent with RCRA ARARs identified in Table 9-4, and these regulations will be incorporated into the design and implementation of this remedy.

12.2.4 Other Guidance Considered

Other guidance TBCs include health-based advisories and guidance and the Draft North Carolina Risk Analysis Framework. TBCs have been used in estimating incremental cancer risk numbers for remedial activities at the site and in determining RCRA applications to contaminated media. The state Risk Analysis Framework was used to develop the performance standards for remediation of secondary source areas.

12.3 COST-EFFECTIVENESS

The Navy and MCAS Cherry Point believe this remedy will control the risks to human health and the environment at an estimated net present worth of $2,300,000 over 30 years. Therefore, based on realistic exposure scenarios, the selected remedy provides an overall effectiveness proportionate to its costs, such that it represents a reasonable value for the money that will be spent.

12.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES (OR RESOURCE RECOVERY TECHNOLOGIES) TO THE MAXIMUM EXTENT PRACTICABLE

The Navy and MCAS Cherry Point, with USEPA and North Carolina concurrence, have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for final remediation of OU2. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Navy and MCAS Cherry Point, with USEPA and North Carolina concurrence, have determined that this selected remedy provides the best

balance of trade-offs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost, while also considering the statutory preference for treatment as a principal element and considering USEPA/State and community acceptance.

The selected alternative would provide permanent, long-term remedies through provision and enforcement of institutional controls in the Air Station Base Master Plan to restrict entry, to prohibit invasive construction activities and installation of wells, and limit the area to nonresidential and/or industrial type uses; by implementing soil treatment; and monitoring the effectiveness of groundwater natural attenuation processes.

The selected remedy treats the principal threats posed by contaminated soil (secondary source areas), achieving significant reductions of volatile organics. This remedy provides the most cost-effective treatment and will cost less than offsite disposal. The selection of treatment of the contaminated soil is consistent with program expectations that indicate that highly toxic and mobile waste are a priority for treatment and often necessary to ensure the long-term effectiveness of a remedy.

12.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

By treating the secondary source area soils using soil vapor extraction, the selected remedy addresses one of the principal threats posed by the site through the use of treatment technologies. By utilizing treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

13.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for Operable Unit 2 was released for public comment on Wednesday, July 23, 1997. The Proposed Plan identified Groundwater Alternative 2 - Natural Attenuation and Institutional Controls and Soil Alternative 3 - Soil Vapor Extraction and Institutional Controls as the preferred alternative for remediation. The Navy and MCAS Cherry Point reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, it was determined that the State of North Carolina has expressed some concerns about the reliability of the uptake modeling of contaminants through the ingestion of fish tissues by human. The Navy and Marine Corps have agreed to collect some fish tissue samples to verify the uptake modeling and assist in assessing the risk to human health through ingestion of fish tissue by humans.

14.0 RESPONSIVENESS SUMMARY

14.1 BACKGROUND ON COMMUNITY INVOLVEMENT

Community relations activities to date are summarized below:

- Established information repositories.
- Established the Administrative Record for all of the sites at the Air Station.
- Released the Proposed Plan for public review in repositories.
- Released public notice announcing public comment and document availability of the Proposed Plan.
- Held public meeting on July 29, 1997 to solicit comments and provide information. The public meeting transcript is available in the repositories and is included in Appendix B.

14.2 SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND NAVY RESPONSES

Following is a summary of the responses to comments received during the public comment period. All comments were received during the public meeting.

1. What was the source of metals at Site 44A?

   Response: The metals were most likely present in the wastewater that was treated at the sewage treatment plant. During treatment, the metals would have been removed from the wastewater and became part of the sludge. The sludge was then applied to the ground at Site 44A.

2. Will the selected remedy be reviewed every five years for effectiveness and to update technologies?

   Response: As required by the Superfund law, five year reviews are required when hazardous substances remain on site at concentrations above health-based levels. The results of the long-

term monitoring will be reviewed at least every five years to confirm that the selected remedy remains effective and protective of human health and the environment. The feasibility of using new technologies could also be evaluated at that time.

3. How long will it take until the site is clean?

Response: The active treatment component, soil vapor extraction, is expected to operate for two to three years. Natural attenuation of groundwater will take longer. Based on modeling, the organic compounds would be removed in 10 to 15 years, most of the metals would be removed in 60 years, and a few metals may not be removed for a very long time. It is difficult to estimate the exact time for natural remediation because the landfill material present at the site. The site will never be totally clean because the landfill material will not be removed.

4. Is the waste that is present below the water table causing a significant contribution to any of the groundwater contamination?

Response: There was little correlation between groundwater contaminant concentrations in the surficial aquifer and whether or not the waste was above or below the water table. There is no significant groundwater contamination in the Yorktown aquifer.

5. How many wells have been installed at OU2? Are they at different depths?

Response: There are approximately 60 permanent monitoring wells installed in the surficial aquifer. Approximately 40 wells are screened in the upper portion of this aquifer, and the remainder are screened in the lower portion of this aquifer. There are sixteen wells installed in the Yorktown aquifer.

6. Will soil vapor extraction remove all of the contaminants, and will any breakdown products be produced?

Response: This technology should not result in toxic breakdown products. Soil vapor extraction is effective for volatile organics. It could also stimulate some biological activity and reduce some of the less volatile organic compounds. It would not be effective for removal of metals. Volatile organics are the main contaminants of concern at OU2.

7. How often will the groundwater be tested?

   Response: The frequency of monitoring will be specified in a monitoring plan that will be developed during the Remedial Design, with the consensus of the Navy, MCAS Cherry Point, and the regulatory agencies. The initial monitoring program may be modified in the future based on a review the results.

8. Has another Operable Unit been added to address contamination in Slocum Creek upstream of OU2 and OU3? Is groundwater discharging to surface water causing the contamination in Slocum Creek?

   Response: Because the source(s) of this contamination and the potential for adverse ecological effects on Slocum Creek are not known, it was decided to implement remedial actions at OU2 and OU3 to address the known sources of contamination. Additional studies will be conducted as part of Operable Unit 15 to define other potential contaminant sources and their impacts on Slocum Creek near OU2 and OU3. Although the concentrations of some chemicals in Slocum Creek are higher than state surface water standards, OU2 does not appear to be the source (or only source) of this. The main contaminants of concern in the groundwater at OU2 are volatile organics; however, the potential contaminants of concern in Slocum Creek are pesticides and metals. The monitoring plan to be developed during the Remedial Design will include sampling of Slocum Creek to confirm that OU2 groundwater is not causing problems in Slocum Creek.

9. Are the primary balancing criteria weighted equally during the evaluation of alternatives and selection of the remedy? Shouldn't long-term effectiveness and reduction of toxicity, mobility, and volume have the highest weighting so that eventually the fencing and warning signs can be removed?

   Response: All of the balancing criteria have an equal weighting. The purpose of the evaluation is to identify important trade-offs among the alternatives, and professional judgment is also used. Most of OU2 is a landfill; therefore, it would not be feasible, and would be very costly, to remove or treat all of the wastes. For this reason, the fences and warning signs will always be needed, and long-term monitoring will be required.

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APPENDIX A

GLOSSARY

This glossary defines terms used in this Record of Decision (ROD) describing CERCLA activities. The definitions apply specifically to this ROD and may have other meanings when used in different circumstances.

Administrative Record: A file that contains all information used by the lead agency to make its decision in selecting a response under CERCLA. This file is to be available for public review and a copy is to be established at or near the site, usually at one of the information repositories. Also a duplicate is filed in a central location, such as a regional or state office.

Aquifer: An underground formation of materials such as sand, soil, or gravel that can store and supply groundwater to wells and springs. Most aquifers used in the United States are within a thousand feet of the earth's surface.

Baseline Risk Assessment: A study conducted as a supplement to a remedial investigation to determine the nature and extent of contamination at a Superfund site and the risks posed to public health and/or the environment.

Carcinogen: A substance that may cause cancer.

Cleanup: Actions taken to deal with a release or threatened release of hazardous substances that could affect public health and/or the environment. The noun "cleanup" is often used broadly to describe various response actions or phases of remedial responses such as Remedial Investigation/Feasibility Study.

Comment Period: A time during which the public can review and comment on various documents and actions taken, either by the Department of Defense installation or the USEPA. For example, a comment period is provided when USEPA proposes to add sites to the National Priorities List.

Community Relations: The Navy and MCAS Cherry Point program to inform and involve the public in the Superfund process and response to community concerns.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A Federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The act created a special tax that goes into a trust fund, commonly known as "Superfund," to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program USEPA can either (1) pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable

to perform the work or (2) take legal action to force parties responsible for site contamination to clean up the site or reimburse the Federal government for the cost of the cleanup.

Defense Environmental Restoration Account (DERA): An account established by Congress to fund Department of Defense hazardous waste site cleanups, building demolition, and hazardous waste minimization. The account was established under the Superfund Amendments and Reauthorization Act.

Drinking Water Standards: Standards for the quality of drinking water that are set by both the USEPA and NCDEHNR.

Explanation of Differences: After adoption of a final remedial action plan, if any remedial or enforcement action is taken, or if any settlement or consent decree is entered into, and if the settlement or decree differs significantly from the final plan, the lead agency is required to publish an explanation of significant differences and why they were made.

Feasibility Study: See Remedial Investigation/Feasibility Study.

Groundwater: Water beneath the earth's surface that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater occurs in sufficient quantities that it can be used for drinking water, irrigation, and other purposes.

Hazard Ranking System (HRS): A scoring system used to evaluate relative risks to public health and the environment from releases or threatened releases of hazardous substances. USEPA and states use the HRS to calculate a site score, from 0 to 100, based on the actual or potential release or hazardous substances from a site through air, surface water, or groundwater to affect people. The score is the primary factor used to decide if a hazardous site should be placed on the NPL.

Hazardous Substances: Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.

Information Repository: A file containing information, technical reports, and reference documents regarding a Superfund site. Information repositories for Marine Corps Air Station Cherry Point are at the Havelock Public Library, 300 Miller Boulevard, Havelock, North Carolina and the MCAS Cherry Point Library, PSC Box 8019, Building 298, "E" Street, Cherry Point, North Carolina.

Maximum Contaminant Level (MCL): National standards for acceptable concentrations of contaminants in public drinking water systems. These are legally enforceable standards for suppliers of drinking water set by the USEPA under the Safe Drinking Water Act.

Monitoring Wells: Wells drilled at specific locations on or off a hazardous waste site where groundwater can be sampled at selected depths and studied to assess the groundwater flow direction and the types and amounts of contaminants present.

National Priorities List (NPL): The USEPAs list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial response using money from the trust fund. The list is based primarily on the score a site receives in the Hazard Ranking System. USEPA is required to update the NPL at least once a year.

Parts Per Billion (ppb)/Parts Per Million (ppm): Units commonly used to express low concentrations of contaminants. For example, one ounce of trichloroethene in a million ounces of water is 1 ppm. One ounce of trichloroethene in a billion ounces of water is 1 ppb. If one drop of trichloroethene is mixed in a competition-size swimming pool, the water will contain about 1 ppb of trichloroethene.

Preliminary Remediation Goals: Screening concentrations that are provided by the USEPA and NCDENR and are used in the assessment of the site for comparative purposes prior to remedial goals being set during the baseline risk assessment.

Proposed Plan: A public participation requirement of SARA in which the lead agency summarizes for the public the preferred cleanup strategy and the rationale for preference, the alternatives presented in the detailed analysis of the Feasibility Study, and presents any waivers to cleanup standards of CERCLA Section 121(d)(4) that may be proposed. This may be prepared either as a fact sheet or a separate document. In either case, it must actively solicit public review and comment on all alternatives under agency consideration.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will used at NPL sites. The Record of Decision is based on information and technical analysis generated during the Remedial Investigation/Feasibility Study and consideration of public comments and community concerns.

Remedial Action (RA): The actual construction or implementation phase that follows the remedial design of the selected cleanup alternative at a site on the NPL.

Remedial Investigation/Feasibility Study (RI/FS): Investigation and analytical studies usually performed at the same time in an interactive process and together referred to as the "RI/FS." They are intended to (1) gather the data necessary to determine the type and extent of contamination at a Superfund site, (2) establish criteria for cleanup up the site, (3) identify and screen cleanup alternatives for remedial action, and (4) analyze in detail the technology and costs of the alternatives.

Remedial Response: A long-term action that stops or substantially reduces a release or threatened release of hazardous substances that is serious, but does not pose an immediate threat to public health and/or the environment.

Removal Action: An immediate action performed quickly to address a release or threatened release of hazardous substances.

Resource Conservation and Recovery Act (RCRA): A Federal law that established a regulatory system to track hazardous wastes from the time of generation to disposal. The law requires safe and secure procedures to be used in treating, transporting, storing, and disposing of hazardous wastes. RCRA is designed to prevent new uncontrolled hazardous waste sites.

Response Action: As defined by Section 101(25) of CERCLA, means remove, removal, remedy, or remedial action, including enforcement activities related hereto.

Responsiveness Summary: A summary of oral and written public comments received by the lead agency during a comment period on key documents and the response to these comments prepared by the lead agency. The responsiveness summary is a key part of the ROD, highlighting community concerns for decision-makers.

Secondary Drinking Water Standards: Secondary drinking water regulations are set by the USEPA and NCDEHNR. These guidelines are not designed to protect public health. Instead they are intended to protect "public welfare" by providing guidelines regarding the taste, odor, color, and other aesthetic aspects of drinking water that do not present a health risk.

Superfund: The trust fund established by CERCLA that can be drawn upon to plan and conduct cleanups of past hazardous waste disposal sites and current releases or threats of releases of non-petroleum products. Superfund is often divided into removal, remedial, and enforcement components.

Superfund Amendments and Reauthorization Act (SARA): The public law enacted on October 17, 1986, to reauthorize the funding provisions and to amend the authorities and requirements of CERCLA and associated laws. Section 120 of SARA requires that all Federal facilities "be subject to and comply with this act in the same manner and to the same extent as any non-government entity."

Surface Water: Bodies of water that are above ground, such as rivers, lakes, and streams.

Volatile Organic Compound (VOC): An organic (carbon-containing) compound that evaporates (volatilizes) readily at room temperature.

APPENDIX B

TRANSCRIPT OF PUBLIC MEETING

APPENDIX C

LAND USE CONTROL IMPLEMENTATION PLAN (LUCIP)

MCAS CHERRY POINT OU2

LAND USE CONTROL IMPLEMENTATION PLAN (LUCIP)

GENERAL

The following details outline the Land Use Control Implementation Plan (LUCIP) for MCAS Cherry Point, OU2. OU2 is comprised of the following sites: Site 10 - Old Sanitary Landfill, Site 44A - Former Sludge Application Area, Site 46 - Polishing Ponds No. 1 and No. 2, and Site 76 - Vehicle Maintenance Area (Hobby Shop). An overall Land Use Control Assurance Plan (LUCAP) is currently being prepared by MCAS Cherry Point. This initial LUCIP is included in the Final Record of Decision (ROD) for the site as an attachment to the ROD; all requirements specified in this LUCIP are to be treated as conditions of the ROD. This initial LUCIP shall be appended to the LUCAP within sixty day (60) of the latter of (a) the date that the ROD for OU2 is signed, and (b) the date that concurrence is received from USEPA and NCDENR on the Final LUCAP.

Subsequent changes to the LUCIP which do not impact the selected remedy will be treated as non-significant changes to the ROD. Other changes to the LUCIP will be documented through the appropriate process to change the ROD (e.g., Explanation of Significant Differences, ROD amendment). Thus, all proposed changes to the LUCIP will be submitted to the State and USEPA for review and concurrence prior to implementation. Proposed changes which receive State and USEPA concurrence will be implemented by modification of the LUCIP maintained with the MCAS Cherry Point LUCAP. Thus, the LUCAP will be maintained as the source of the current LUCIP for the site, as documented through the changes to the ROD. The LUCIP for OU2 will be updated at least annually to include revised site boundaries and boundaries of site restrictions based on current status remedial actions and monitoring results.

Because the LUCAP for MCAS Cherry Point is not yet completed, it is understood by all parties that the concurrence by USEPA and NCDENR of the ROD for OU2 is dependent upon MCAS Cherry Point's timely completion of the LUCAP and future compliance with the terms of the LUCAP. If the LUCAP is not completed in a timely manner, or if once the LUCAP is completed, MCAS Cherry Point fails to substantially comply with its provisions or the LUCAP is unilaterally terminated, the protectiveness of the remedy selected in the ROD may be reconsidered, and additional measures may be required to adequately ensure future protection of human health and the environment. The LUCAP and LUCIPs for those sites which have signed RODs that pre-date the LUCAP are currently scheduled for submittal no later than December 31, 1998.

MONITORING PROGRAM

- MCAS Cherry Point shall conduct site monitoring of groundwater to evaluate the effectiveness of the soil treatment on groundwater contaminant levels and the progress of the natural attenuation of groundwater contaminants. MCAS Cherry Point shall also conduct monitoring of surface water and sediment in Slocum Creek and Turkey Gut. Monitoring will also serve to ensure that there are no further releases from the site that could cause unacceptable risks to human health or the environment.

- Within 180 days of the date that the Final Record of Decision for OU2 is signed, MCAS Cherry Point shall submit a Monitoring Plan for OU2 to USEPA and NCDENR for concurrence. The Monitoring Plan shall be prepared in accordance with applicable or relevant and appropriate Federal and State regulations and guidance. The initial plan shall at a minimum specify the frequency, type, and locations of the long-term monitoring samples.

- The Monitoring Plan shall include provisions for loading of periodic monitoring event results into the basewide Geographic Information System (GIS). Periodic monitoring event results include (1) analytical results from samples collected during the monitoring event, (2) location information of any new monitoring wells installed during the event, and (3) a status notation ("abandoned") for any monitoring wells permanently removed from service.

- Changes to the Monitoring Plan (including changes to sampling frequency, media samples, sample locations, analyses performed, and installation or abandonment of monitoring wells) may be required by USEPA or NCDENR, or proposed by MCAS Cherry Point based on review of results from the regular monitoring program or other circumstances. Changes to the Monitoring Plan shall be submitted to USEPA and NCDENR for concurrence as non-significant changes to the ROD.

- Monitoring may be discontinued upon demonstration that continued attainment of remedial goals has been achieved. Discontinuation of the monitoring program shall be submitted for USEPA and NCDENR concurrence as a non-significant change to the ROD.

SITE BOUNDARY IDENTIFICATION

- The geographic boundary of OU2 is identified in Figure C-1. This boundary indicates the composite outermost border of all restricted portions of the site (i.e., no restricted areas lie outside this boundary).

LAND USE RESTRICTIONS

- The land use at OU2 will be restricted to industrial uses only. Prohibited land uses include, but are not limited to, residences, schools, playgrounds, day cares, and retirement centers.

- Intrusive activities (e.g., excavation of soil or insertion of objects into the ground surface, except for monitoring purposes) are prohibited. Specific exceptions may be made with NCDENR and USEPA concurrence.

- Specific geographic boundaries of the land use restrictions for intrusive activities are identified in Figure C-1.

AQUIFER USE RESTRICTIONS

- All use of groundwater located beneath OU2, other than for monitoring purposes, is prohibited.

- The installation of any well, other than those constructed for monitoring purposes pursuant to 15A NCAC 2C.0108 as determined by NCDENR.

- Specific geographic boundaries of the restricted aquifers are identified in Figure C-1.

SITE ACCESS RESTRICTIONS

- Site access is restricted to authorized personnel only. Site access controls will include the installation of a fence around the polishing ponds, repair and replacement of existing fencing around the OU2 landfill, and the placement of warning signs along the fence, Slocum Creek, and Turkey Gut to warn all unauthorized persons to stay out.

NOTIFICATION

- Within 180 days of the date that the Final Record of Decision for OU2 is signed, MCAS Cherry Point shall submit for NCDENR concurrence a plat entitled "Notice of Inactive Hazardous Substance or Waste Disposal Site" ("Notice"). The Notice shall include a legal description of the site that would be sufficient as a description in an instrument of conveyance, shall meet the requirements of NCGS 47-30 for maps and plats, and shall identify:

(1) The location and dimensions of the disposal areas and areas of potential environmental concern with respect to permanently surveyed benchmarks.

(2) The type, location, and quantity of hazardous substances known by the owner of the site to exist on the site.

(3) The institutional controls required under this ROD other than the Notice.

The Notice shall also include the following statements:

(1) The Notice in no way should be interpreted as a disposition or alienation of any real property interest held by the United States for the property in question.

(2) The Notice creates no independent enforcement authorities in the State or third parties.

(3) Nothing in the Notice should be construed to create any obligation inconsistent with those imposed on the Navy/Marine Corps under the CERCLA Decision Document (Record of Decision) for the site.

- Within 15 days of receipt of NCDENR concurrence with the Notice, MCAS Cherry Point shall file the copy of the Notice concurred with by NCDENR and shall send to NCDENR a copy thereof certifying filing by the Craven County Register of Deeds Office.

AIR STATION IMPLEMENTATION

- Within sixty (60) days of the date that the Final Record of Decision for OU2 is signed, the land use and aquifer use restrictions described in the Record of Decision (collectively referred to as "site restrictions") shall be provided to the MCAS Cherry Point planning department for immediate implementation and inclusion in the next publication of the Air Station's Base Master Plan (BMP). the BMP is updated approximately every five (5) years. A copy of the site restrictions as inserted into the BMP will be provided to NCDENR and USEPA upon publication. In addition, a copy of the site restrictions as inserted into each subsequent publication of the BMP will be provided to NCDENR and USEPA upon publication as long as the restrictions remain in effect.

- Within sixty (60) days of the latter of (a) the date that the Final ROD for OU2 is signed and (b) the date that the MCAS Cherry Point GIS system modification to allow inclusion of specific boundaries of site restrictions is completed, MCAS Cherry Point shall record the specific boundaries of site restrictions as described in this ROD in the basewide Geographic Information System (GIS) and provide NCDENR written notification of such recording. The MCAS Cherry Point GIS system is currently being modified to allow inclusion of specific boundaries of site restrictions as follows: (a) overall site boundary

(inclusive of all areas of previous investigation and current areas of concern), (b) limits of groundwater contamination and groundwater use restrictions, (c) limits of soil contamination and land use restrictions, (d) limits of surface water and sediment contamination. This modification is anticipated to be completed by July 15, 1999.

- Within sixty (60) days of the date that the Final OU2 ROD is signed, MCAS Cherry Point shall record in the basewide GIS (a) the location of all permanent monitoring wells remaining at OU2 at the signing of this ROD, and (b) all analytical results of samples collected from these monitoring wells during the remedial investigation.

- Within sixty (60) days of submission of periodic monitoring event results to USEPA and NCDENR, MCAS Cherry Point shall record in the basewide GIS (a) all analytical results of samples collected during the monitoring event, (b) the location of any new permanent monitoring wells installed on site during the event, and (c) a status notation of "abandoned" for any monitoring wells permanently removed from service.

- The Commanding General, MCAS Cherry Point, or his designee, will submit to NCDENR and USEPA at least annually a certification that compliance with the site restrictions as specified in this ROD, or as modified with USEPA and NCDENR concurrence, has been confirmed through visual inspection and that the restrictions are being actively enforced. In the event that deviations from this condition have been implemented with concurrence from NCDENR and USEPA, then this certification will fully describe such deviations and provide or reference appropriate supporting documentation. To reduce administrative burden, this certification may occur concurrently with certification for other sites at MCAS Cherry Point such that a single certification document encompassing all applicable sites is submitted once each year.

- Within sixty (60) days of the latter of (a) date that the Final OU2 ROD is signed, and (b) the date that concurrence is received from USEPA and NCDENR on the LUCAP for MCAS Cherry Point the site restrictions specified in this LUCIP shall be incorporated into the LUCAP.

- Modifications to the site restrictions specified int he ROD require USEPA and NCDENR concurrence. Proposed modifications which receive such concurrence shall be updated in appropriate documentation following the relevant and appropriate procedures outline for implementation of this ROD. Examples include, but are not limited to, the Base Master Plan, the basewide GIS, the LUCAP/LUCIP, and the Notification of Inactive Hazardous Substance or Waste Disposal Site.

PROPERTY TRANSFER

- If the site is every transferred to another Federal government entity ("transferee"), the Navy/Marine Corps shall take the following steps to ensure that the site restrictions described above will remain in effect after the transfer:

  (1) The transfer document shall contain in the description section, in type no smaller than that used in the body of the document, a statement that the property has been used as a hazardous waste disposal site, a reference by book and page to the recordation of the Notice described under "Notification" section above, and shall have attached to it a copy of that Notice.

  (2) The transfer document shall identify the institutional controls included in this ROD and require that these restrictions be upheld by the transferee.

  (3) The transfer document shall identify the transferee's responsibilities and any continuing Navy/Marine Corps responsibilities with regards to upholding the requirements of the ROD, such that all responsibilities identified in this ROD are clearly assigned. These responsibilities include site restrictions, site maintenance (monitoring wells, monitoring events, reporting, and transfer/conveyance requirements).

- If the site is ever leased or a temporary easement is granted to a non-Federal entity ("tenant"), the Navy/Marine Corps shall take the following steps to ensure that the institutional control described above will remain in effect during the lease period:

  (1) The lease or temporary easement ("transfer document") shall contain in the description section, in type no smaller than that used in the body of the document, a statement that the property has been used as a hazardous waste disposal site, a reference by book and page to the recordation of the Notice described under "Notification" section above, and shall have attached to it a copy of that Notice.

  (2) The lease shall identify the site restrictions established in the ROD and the requirement that these restrictions be upheld by the tenant.

- If the site is ever sold, conveyed, or transferred, or if a permanent easement is granted to a non-Federal entity ("transferee"), and the Navy/Marine Corps is the agency empowered to conduct the real estate transaction, the Navy/Marine Corps shall take the following steps to ensure that the institutional controls described above will remain in effect after the transfer:

(1) The deed or other instrument of transfer ("transfer document") shall contain in the description section, in type no smaller than that used in the body of the document, a statement that the property has been used as a hazardous waste disposal site, a reference by book and page to the recordation of the Notice described under "Notification" section above, and shall have attached to it a copy of that Notice.

(2) The transfer document shall have attached to it a copy of the Notice.

(3) The transfer document shall include a covenant which imposes the same site restrictions as described in the ROD.

- If the site is ever sold, conveyed, or transferred, or if a permanent easement is granted to a non-Federal entity ("transferee"), and the Navy/Marine Corps is not the agency empowered to conduct the real estate transaction, the Navy/Marine Corps shall take all steps necessary and permissible to ensure that the disposal agency takes the steps described in the preceding paragraph, unless the property has been remediated to residential standards prior to such transfer. In any event, the disposal agency shall be responsible for taking the steps described in the preceding paragraph absent prior remediation to residential standards.

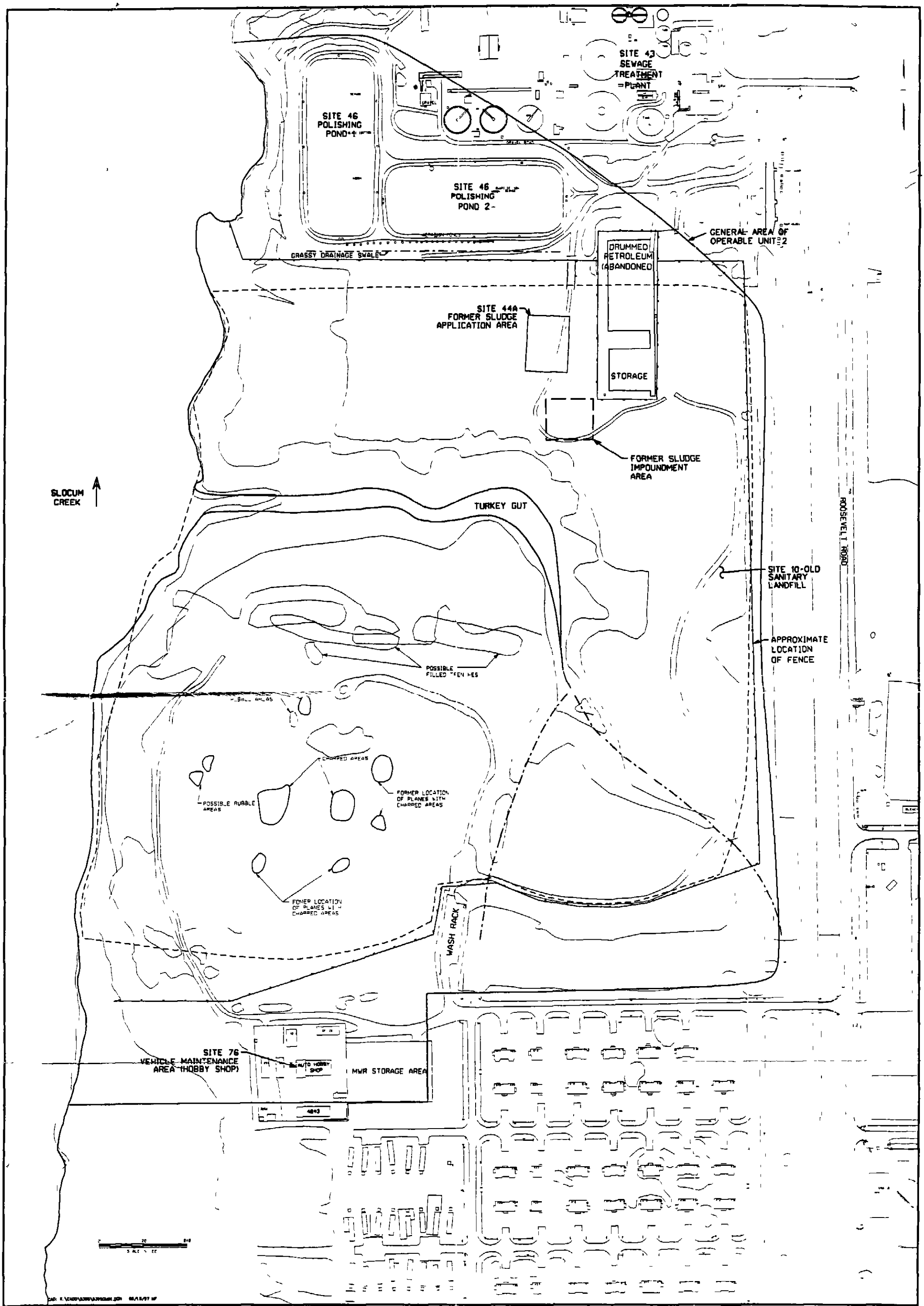

FIGURE C-1

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION NORFOLK, VIRGINIA

MARINE CORPS AIR STATION CHERRY POINT CHERRY POINT NORTH CAROLINA

OU2

GENERAL SITE LOCATION MAP

Brown & Root Environmental

ACTIVITY – SATISFACTORY TO

REVISIONS

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